PURE MATHEMATICS -3
9709
(March, June and November series 2020 – 2023 With marking scheme)
POLYNOMIAL AND MODULUS FUNCTIONS
EXERCISE -1

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1) SP-2020 _9709_3 Q3

(a) Sketch the graph of $y = |2x - 3|$. [1]

(b) Solve the inequality $3x - 1 > |2x - 3|$. [3]

2) MARCH 2020_9709_32 Q1

(a) Sketch the graph of $y = |x - 2|$. [1]

(b) Solve the inequality $|x - 2| < 3x - 4$. [3]

3) MARCH 2021_9709_32 Q2

The polynomial $ax^3 + 5x^2 - 4x + b$, where a and b are constants, is denoted by $p(x)$. It is given that $(x + 2)$ is a factor of $p(x)$ and that when $p(x)$ is divided by $(x + 1)$ the remainder is 2.

Find the values of a and b. [5]

4) MARCH 2022_9709_32 Q1

Solve the inequality $|2x + 3| > 3|x + 2|$. [4]

5) MARCH 2022_9709_32 Q8(a)

Find the quotient and remainder when $8x^3 + 4x^2 + 2x + 7$ is divided by $4x^2 + 1$. [3]

6) MARCH 2023_9709_32 Q3

The polynomial $2x^4 + ax^3 + bx - 1$, where a and b are constants, is denoted by $p(x)$. When $p(x)$ is divided by $x^2 - x + 1$ the remainder is $3x + 2$.

Find the values of a and b. [5]

7) JUNE 2020_9709_31 Q5(a)

Find the quotient and remainder when $2x^3 - x^2 + 6x + 3$ is divided by $x^2 + 3$. [3]

8) JUNE 2020_9709_32 Q1

Find the quotient and remainder when $6x^4 + x^3 - x^2 + 5x - 6$ is divided by $2x^2 - x + 1$. [3]

9) JUNE 2020_9709_33 Q1

Solve the inequality $|2x - 1| > 3|x + 2|$. [4]

10) JUNE 2021_9709_31 Q1

Solve the inequality $2|3x - 1| < |x + 1|$. [4]

11) JUNE 2021_9709_32 Q1

Solve the inequality $|2x - 1| < 3|x + 1|$. [4]

12) JUNE 2022_9709_31 Q5

The polynomial $ax^3 - 10x^2 + bx + 8$, where a and b are constants, is denoted by $p(x)$. It is given that $(x - 2)$ is a factor of both $p(x)$ and $p'(x)$.

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

(b) When a and b have these values, factorise $p(x)$ completely. [3]

13) JUNE 2022_9709_32 Q3

The polynomial $ax^3 + x^2 + bx + 3$ is denoted by $p(x)$. It is given that $p(x)$ is divisible by $(2x - 1)$ and that when $p(x)$ is divided by $(x + 2)$ the remainder is 5.

Find the values of a and b. [5]

14) JUNE 2022_9709_33 Q1

Find, in terms of a, the set of values of x satisfying the inequality

$$2|3x + a| < |2x + 3a|,$$

where a is a positive constant. [4]

15) JUNE 2023_9709_31 Q2

(a) Sketch the graph of $y = |2x + 3|$. [1]

(b) Solve the inequality $3x + 8 > |2x + 3|$. [3]

16) JUNE 2023_9709_32 Q1

Solve the inequality $|5x - 3| < 2|3x - 7|$. [4]

17) JUNE 2023_9709_33 Q2

Find the quotient and remainder when $2x^4 - 27$ is divided by $x^2 + x + 3$. [3]

18) OCT 2020_9709_31 Q1

Solve the inequality $2 - 5x > 2|x - 3|$. [4]

19) OCT 2021_9709_32 Q2

Solve the inequality $|3x - a| > 2|x + 2a|$, where a is a positive constant. [4]

20) OCT 2021_9709_33 Q1

Find the quotient and remainder when $2x^4 + 1$ is divided by $x^2 - x + 2$. [3]

21) OCT 2021_9709_33 Q2

(a) Sketch the graph of $y = |2x - 3|$. [1]

(b) Solve the inequality $|2x - 3| < 3x + 2$. [3]

22) OCT 2022_9709_31 Q1

(a) Sketch the graph of $y = |2x + 1|$. [1]

(b) Solve the inequality $3x + 5 < |2x + 1|$. [3]

23) OCT 2022_9709_32 Q2

The polynomial $2x^3 - x^2 + a$, where a is a constant, is denoted by $p(x)$. It is given that $(2x + 3)$ is a factor of $p(x)$.

(a) Find the value of a. [2]

(b) When a has this value, solve the inequality $p(x) < 0$. [4]

MARKING SCHEME

1) SP-2020 _9709_3 Q3

(a)	Make a recognisable sketch graph of $y = \|2x-3\|$	1	B1
(b)	**EITHER** Solution 1 Find x-coordinate of intersection with $y = 3x - 1$	1	(M1
	Obtain $x = \frac{4}{5}$	1	A1
	State final answer $x > \frac{4}{5}$ only	1	A1)
	OR Solution 2 Solve the linear inequality $3x - 1 > 3 - 2x$, or corresponding equation	1	(M1
	Obtain critical value $x = \frac{4}{5}$	1	A1
	State final answer $x > \frac{4}{5}$ only	1	A1)
	OR Solution 3 Solve the quadratic inequality $(3x-1)^2 > (3-2x)^2$, or corresponding equation	1	(M1
	Obtain critical value $x = \frac{4}{5}$	1	A1
	State final answer $x > \frac{4}{5}$ only	1	A1)
	Available marks	3	

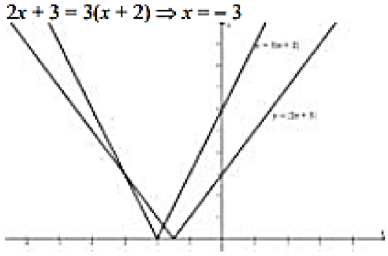
2) MARCH 2020_9709_32 Q1

a)	Make a recognisable sketch graph of $y = \|x-2\|$	B1
		1
b)	Find x-coordinate of intersection with $y = 3x - 4$	M1
	Obtain $x = \frac{3}{2}$	A1
	State final answer $x > \frac{3}{2}$ only	A1
	Alternative method for question 1(b)	
	Solve the linear inequality $3x-4>2-x$, or corresponding equation	M1
	Obtain critical value $x = \frac{3}{2}$	A1
	State final answer $x > \frac{3}{2}$ only	A1
	Alternative method for question 1(b)	
	Solve the quadratic inequality $(x-2)^2 < (3x-4)^2$, or corresponding equation	M1
	Obtain critical value $x = \frac{3}{2}$	A1
	State final answer $x > \frac{3}{2}$ only	A1

3) MARCH 2021_9709_32 Q2

Substitute $x = -2$, equate result to zero and obtain a correct equation, e.g. $-8a + 20 + 8 + b = 0$	B1
Substitute $x = -1$ and equate result to 2	M1
Obtain a correct equation, e.g. $-a + 5 + 4 + b = 2$	A1
Solve for a or for b	M1
Obtain $a = 3$ and $b = -4$	A1

4) MARCH 2022_9709_32 Q1

State or imply non-modular inequality $(2x+3)^2 > 3^2(x+2)^2$, or corresponding quadratic equation, or pair of linear equations	B1	
Make a reasonable attempt at solving a 3-term quadratic, or solve two linear equations for x	M1	Quadratic formula or $(5x + 9)(x + 3)$
Obtain critical values $x = -3$ and $x = -\frac{9}{5}$	A1	OE
State final answer $-3 < x < -\frac{9}{5}$ or $x > -3$ and $x < -\frac{9}{5}$	A1	[Do not condone $\leqslant$ for $<$ in the final answer.] No ISW
Alternative method for question 1		
Obtain critical value $x = -3$ from a graphical method, or by solving a linear equation or linear inequality	B1	$2x + 3 = 3(x + 2) \Rightarrow x = -3$ 
Obtain critical value $x = -\frac{9}{5}$ similarly	B2	
State final answer $-3 < x < -\frac{9}{5}$ or $x > -3$ and $x < -\frac{9}{5}$	B1	[Do not condone $\leqslant$ for $<$ in the final answer.] No ISW

5) MARCH 2022_9709_32 Q8(a)

Commence division and reach quotient of the form $2x \pm 1$	M1
Obtain (quotient) $2x + 1$	A1
Obtain (remainder) 6	A1

6) MARCH 2023_9709_32 Q3

Commence division and reach partial quotient $2x^2 + (a \pm 2)x$	M1	$2x^2 + (a + 2)x + a$ need $2x^2 + (a \pm 2)x$ $(x^2 - x + 1)\ 2x^4 + ax^3 + 0x^2 + bx - 1$ $2x^4 - 2x^3 + 2x^2$ $(a + 2)x^3 - 2x^2 + bx$ $(a + 2)x^3 - (a + 2)x^2 + (a + 2)x$ $ax^2 + (b - (a + 2))x - 1$ $ax^2 - ax + a$ $(b - 2)x - (1 + a)$ $3x + 2$ Working backwards from remainder: $2x^2 + (\ldots)x \pm 3$ **M1** $2x^2 - x - 3$ **A1**
Obtain correct quotient $2x^2 + (a + 2)x + a$	A1	Allow sign error e.g. in $b - 2$.
Set *their* linear remainder equal to part of "$3x + 2$" and solve for a or for b	M1	Remainder $= 3x + 2 = (b - 2)x - 1 - a$. Allow for just equating x term or constant term.
Obtain answer $a = -3$	A1	
Obtain answer $b = 5$	A1	

Alternative method for Question 3		
State $2x^4 + ax^3 + 0x^2 + bx - 1 = (x^2 - x + 1)(2x^2 + Ax + B) + 3x + 2$ and form and solve equation(s) to obtain A or B	**M1**	e.g. $0 = B - A + 2$ and $-1 = B + 2$.
Obtain $A = -1$, $B = -3$	**A1**	
Form and solve equations for a or for b	**M1**	e.g. $a = A - 2$ or $b = -B + A + 3$.
Obtain answer $a = -3$	**A1**	
Obtain answer $b = 5$	**A1**	
Alternative method for Question 3		
Use remainder theorem with $x = \frac{1 \pm \sqrt{-3}}{2}$ or $x = \frac{1 \pm i\sqrt{3}}{2}$	**M1**	Allow for correct use of a reasonable attempt at either root in exact or decimal form in the remainder theorem $x^2 = \frac{-1+\sqrt{-3}}{2}$ $x^3 = -1$ $x^4 = \frac{-1-\sqrt{-3}}{2}$.
Obtain $-a + \frac{b}{2} \pm \frac{b\sqrt{-3}}{2} \mp \sqrt{-3} - 2 = \frac{7}{2} \pm \frac{3\sqrt{-3}}{2}$ or $-a + \frac{b}{2} \pm \frac{bi\sqrt{3}}{2} \mp i\sqrt{3} - 2 = \frac{7}{2} \pm \frac{3i\sqrt{3}}{2}$	**A1**	Expand brackets and obtain exact equation for either root. Accept exact equivalent.
Solve simultaneous equations, or single equation, for a or for b	**M1**	
Obtain answer $a = -3$ from exact working	**A1**	
Obtain answer $b = 5$ from exact working	**A1**	
	5	

7) JUNE 2020_9709_31 Q5(a)

(a)	Commence division and reach quotient of the form $2x + k$	**M1**
	Obtain quotient $2x - 1$	**A1**
	Obtain remainder 6	**A1**
		3

8) JUNE 2020_9709_32 Q1

Commence division and reach partial quotient $3x^2 + kx$	**M1**
Obtain quotient $3x^2 + 2x - 1$	**A1**
Obtain remainder $2x - 5$	**A1**
	3

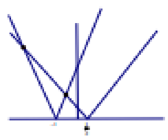
9) JUNE 2020_9709_33 Q1

State or imply non-modular inequality $(2x-1)^2 > 3^2(x+2)^2$, or corresponding quadratic equation, or pair of linear equations	**B1**
Make reasonable attempt at solving a 3-term quadratic, or solve two linear equations for x	**M1**
Obtain critical values $x = -7$ and $x = -1$	**A1**
State final answer $-7 < x < -1$	**A1**
Alternative method for question 1	
Obtain critical value $x = -1$ from a graphical method, or by solving a linear equation or linear inequality	**B1**
Obtain critical value $x = -7$ similarly	**B2**
State final answer $-7 < x < -1$ [Do not condone $\leqslant$ for $<$ in the final answer.]	**B1**

10) JUNE 2021_9709_31 Q1

State or imply non-modular inequality $2^2(3x-1)^2 < (x+1)^2$, or corresponding quadratic equation, or pair of linear equations	B1
Form and solve a 3-term quadratic, or solve two linear equations for x	M1
Obtain critical values $x = \frac{3}{5}$ and $x = \frac{1}{7}$	A1
State final answer $\frac{1}{7} < x < \frac{3}{5}$	A1
Alternative method for Question 1	
Obtain critical value $x = \frac{3}{5}$ from a graphical method, or by solving a linear equation or linear inequality	B1
Obtain critical value $x = \frac{1}{7}$ similarly	B2
State final answer $\frac{1}{7} < x < \frac{3}{5}$	B1

11) JUNE 2021_9709_32 Q1

State or imply non-modular inequality $(2x-1)^2 < 3^2(x+1)^2$, or corresponding quadratic equation	B1	e.g. $5x^2 + 22x + 8 = 0$ Allow recovery from 'invisible brackets' on RHS
Form and solve a 3-term quadratic in x	M1	
Obtain critical values $x = -4$ and $x = -\frac{2}{5}$	A1	
State final answer $x < -4,\ x > -\frac{2}{5}$	A1	Do not condone $\leqslant$ for $<$, or $\geqslant$ for $>$ in the final answer. Allow 'or' but not 'and'. $-\frac{2}{5} < x < -4$ scores A0. Accept equivalent forms using brackets e.g. $x \in (-\infty, -4) \cup (-0.4, \infty)$
Alternative method for Question 1		
Obtain critical value $x = -4$ from a graphical method, or by solving a linear equation or linear inequality	B1	
Obtain critical value $x = -\frac{2}{5}$ similarly	B2	
State final answer $x < -4,\ x > -\frac{2}{5}$	B1	Do not condone $\leqslant$ for $<$, or $\geqslant$ for $>$ in the final answer. Allow 'or' but not 'and'. $-\frac{2}{5} < x < -4$ scores A0. Accept equivalent forms using brackets e.g. $x \in (-\infty, -4) \cup (-0.4, \infty)$

12) JUNE 2022_9709_31 Q5

(a)	Substitute $x = 2$, equate to zero	M1
	Obtain a correct equation, e.g. $8a - 40 + 2b + 8 = 0$	A1
	Differentiate $p(x)$, substitute $x = 2$ and equate result to zero	M1
	Obtain $12a - 40 + b = 0$, or equivalent	A1
	Obtain $a = 3$ and $b = 4$	A1
	Alternative method for question 5(a)	
	State or imply $(x-2)^2$ is a factor	M1
	$p(x) = (x-2)^2(ax+2)$	A1
	Obtain an equation in b	M1
	e.g. by comparing coefficients of x: $b = 4a - 8$	A1
	Obtain $a = 3$ and $b = 4$	A1
(b)	Attempt division by $(x - 2)$	M1
	Obtain quadratic factor $3x^2 - 4x - 4$	A1
	Obtain factorisation $(3x+2)(x-2)(x-2)$	A1
	Alternative method for question 5(b)	
	State or imply $(x-2)^2$ is a factor	B1
	Attempt division by $(x-2)^2$, reaching a quotient $ax + k$ or use inspection with unknown factor $cx + d$ reaching a value for c or for d	M1
	Obtain factorisation $(3x+2)(x-2)^2$	A1

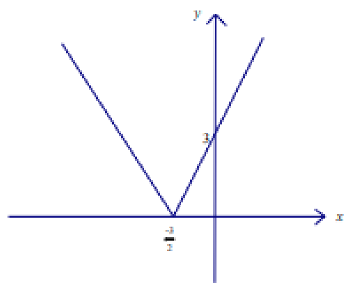
13) JUNE 2022_9709_32 Q3

Substitute $x = \frac{1}{2}$, equate result to zero	M1
Obtain a correct simplified equation	A1
Substitute $x = -2$, equate result to 5	M1
Obtain a correct simplified equation	A1
Obtain $a = 2$ and $b = -7$	A1
	5

14) JUNE 2022_9709_33 Q1

State or imply non-modular inequality $2^2(3x+a)^2 < (2x+3a)^2$, or corresponding quadratic equation, or pair of linear equations	B1
Solve 3-term quadratic, or solve two linear equations for x	M1
Obtain critical values $x = \frac{1}{4}a$ and $x = -\frac{5}{8}a$	A1
State final answer $-\frac{5}{8}a < x < \frac{1}{4}a$ or $-0.625a < x < 0.25a$ or $x > -\frac{5}{8}a$ **and** $x < \frac{1}{4}a$ or $x > -\frac{5}{8}a \cap x < \frac{1}{4}a$	A1
Alternative method for question 1	
Obtain critical value $x = \frac{1}{4}a$ from a graphical method, or by solving a linear equation or linear inequality	B1
Obtain critical value $x = -\frac{5}{8}a$ similarly	B2
State final answer $-\frac{5}{8}a < x < \frac{1}{4}a$ or $-0.625a < x < 0.25a$ or $x > -\frac{5}{8}a$ **and** $x < \frac{1}{4}a$ or $x > -\frac{5}{8}a \cap x < \frac{1}{4}a$	B1
	4

15) JUNE 2023_9709_31 Q2

a)		B1	Show a recognizable sketch graph of $y = \|2x+3\|$. (Ignore any attempt to sketch $y = 3x + 8$). Straight lines. Vertex in approximately correct position on x axis. Symmetry.
		1	

b)			
	Find x-coordinate of intersection with $y = 3x + 8$	M1	
	Obtain $x = -\frac{11}{5}$	A1	
	State final answer $x > -\frac{11}{5}$ only	A1	$(x > -2.2)$ Do not condone $\geqslant$ for $>$.
	Alternative Method 1		
	Solve the linear inequality $3x + 8 > -(2x + 3)$, or corresponding linear equation	M1	
	Obtain critical value $x = -\frac{11}{5}$	A1	
	State final answer $x > -\frac{11}{5}$ only	A1	$(x > -2.2)$ Do not condone $\geqslant$ for $>$.
	Alternative Method 2		
	Solve the quadratic inequality $(3x+8)^2 > (2x+3)^2$, or corresponding quadratic equation	(M1)	$5x^2 + 36x + 55$.
	Obtain critical value $x = -\frac{11}{5}$	(A1)	Ignore -5 if seen.
	State final answer $x > -\frac{11}{5}$ only	(A1)	$(x > -2.2)$ Do not condone $\geqslant$ for $>$.

16) JUNE 2023_9709_32 Q1

State or imply non-modular inequality $(5x-3)^2 < 2^2(3x-7)^2$, or corresponding quadratic equation, or pair of linear equations $(5x - 3) = \pm 2(3x - 7)$	B1	$11x^2 - 138x + 187 > 0$.
Solve a 3-term quadratic, or solve **two** linear equations for x	M1	If no working is shown, the M1 is implied by the correct roots for an incorrect quadratic.
Obtain critical values $x = \frac{17}{11}$ and $x = 11$	A1	Accept 1.55 or better.
State **final** answer $x < \frac{17}{11}$, $x > 11$	A1	Strict inequality required. In set notation, allow notation for open sets but not for closed sets e.g. accept $\left(-\infty, \frac{17}{11}\right) \cup (11, \infty)$ or $(-\infty, \frac{17}{11}[\cup]11, \infty)$ but not $(-\infty, \frac{17}{11}] \cup [11, \infty)$. Allow 'or' but not 'and'. Accept $\cup$. Final A0 for $\frac{17}{11} > x > 11$. Exact values expected but ISW if exact inequalities seen followed by decimal approx.
Alternative Method for Question 1		
Obtain critical value $x = 11$ from a graphical method, or by inspection, or by solving a linear equation or an inequality	B1	
Obtain critical value $x = \frac{17}{11}$ similarly	B2	Accept decimal value.
State final answer $x < \frac{17}{11}$, $x > 11$	B1	Strict inequality required. See notes above.

17) JUNE 2023_9709_33 Q2

Divide to obtain quotient $2x^2 \pm 2x + k\ (k \neq 0)$	M1	Obtain result in answer column, together with a linear polynomial or a constant as remainder. If correct: $\begin{array}{r l} & 2x^2 - 2x - 4 \\ x^2 + x + 3 & \overline{2x^4 \qquad\qquad\qquad - 27} \\ & 2x^4 + 2x^3 + 6x^2 \\ & \overline{-2x^3 - 6x^2} \\ & -2x^3 - 2x^2 - 6x \\ & \overline{-4x^2 + 6x - 27} \\ & -4x^2 - 4x - 12 \\ & \overline{10x - 15} \end{array}$
Obtain [quotient] $2x^2 - 2x - 4$	A1	Allow unless quotient and remainder interchanged, then A0 A1.
Obtain [remainder] $10x - 15$	A1	Allow $(x^2 + x + 3)(2x^2 - 2x - 4) + 10x - 15$.
Alternative Method for Question 2		
Expand $(x^2 + x + 3)(Ax^2 + Bx + C) + (Dx + E)$ and reach $A = 2$, $B = \pm 2$, $C = k$	M1	Solve all 3 equations for A, B and C, allow sign errors in establishing equations and in solving. If correct, $A = 2$, $A + B = 0$, $3A + B + C = 0$, $3B + C + D = 0$, $3C + E = -27$. Obtain result in answer column, together with a linear polynomial or a constant as remainder.
Obtain [quotient] $2x^2 - 2x - 4$	A1	Allow unless quotient and remainder interchanged, then A0 A1.
Obtain [remainder] $10x - 15$	A1	Allow $(x^2 + x + 3)(2x^2 - 2x - 4) + 10x - 15$.
	3	

18) OCT 2020_9709_31 Q1

Make a recognisable sketch graph of $y = 2\|x - 3\|$ and the line $y = 2 - 5x$	B1	Need to see correct V at $x = 3$, roughly symmetrical, $x = 3$ stated, domain at least $(-2, 5)$.
Find x-coordinate of intersection with $y = 2 - 5x$	M1	Find point of intersection with $y = 2\|x - 3\|$ or solve $2 - 5x$ with $2(x - 3)$ or $-2(x - 3)$
Obtain $x = -\frac{4}{3}$	A1	
State final answer $x < -\frac{4}{3}$	A1	Do not accept $x < -1.33$ [Do not condone $\leqslant$ for $<$ in the final answer.]
Alternative method for question 1		
State or imply non-modular inequality/equality $(2 - 5x)^2 >, \geqslant, =, 2^2(x - 3)^2$, or corresponding quadratic equation, or pair of linear equations $(2 - 5x) >, \geqslant, =, \pm 2(x - 3)$	B1	Two correct linear equations only
Make reasonable attempt at solving a 3-term quadratic, or solve one linear equation, or linear inequality for x	M1	$21x^2 + 4x - 32 = (3x + 4)(7x - 8) = 0$ $2 - 5x$ or $-(2 - 5x)$ with $2(x - 3)$ or $-2(x - 3)$
Obtain critical value $x = -\frac{4}{3}$	A1	
State final answer $x < -\frac{4}{3}$	A1	Do not accept $x < -1.33$ [Do not condone $\leqslant$ for $<$ in the final answer.]
	4	

19) OCT 2021_9709_32 Q2

State or imply non-modular inequality $(3x-a)^2 > 2^2(x+2a)^2$, or corresponding quadratic equation, or pair of linear equations or linear inequalities	B1	Need 2^2 seen or implied.
Make reasonable attempt to solve a 3-term quadratic, or solve two linear equations for x in terms of a	M1	$(5x^2 - 22ax - 15a^2 = 0)$
Obtain critical values $x = 5a$ and $x = -\frac{3}{5}a$ and no others	A1	OE Accept incorrect inequalities with correct critical values. Must state 2 values i.e. $\frac{a \pm b}{c}$ is not sufficient.
State final answer $x > 5a$, $x < -\frac{3}{5}a$	A1	Do not condone $\geqslant$ for $>$ or $\leqslant$ for $<$ in the final answer. $5a < x < -\frac{3}{5}a$ is **A0**, 'and' is **A0**.
Alternative method for Question 2		
Obtain critical value $x = 5a$ from a graphical method, or by solving a linear equation or linear inequality	B1	
Obtain critical value $x = -\frac{3}{5}a$ similarly	B2	Maximum 2 marks if more than 2 critical values.
State final answer $x > 5a$, $x < -\frac{3}{5}a$	B1	Do not condone $\geq$ for $>$ or $\leq$ for $<$ in the final answer. $5a < x < -\frac{3}{5}a$ is **B0**, 'and' is **B0**.
	4	

20) OCT 2021_9709_33 Q1

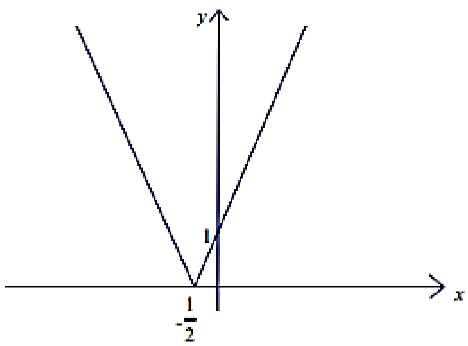
Commence division and reach partial quotient of the form $2x^2 + kx$	M1
Obtain quotient $2x^2 + 2x - 2$	A1
Obtain remainder $-6x + 5$	A1

21) OCT 2021_9709_33 Q2

2(a)	Show a recognizable sketch graph of $y = \lvert 2x-3 \rvert$	B1
		1

Find x-coordinate of intersection with $y = 3x + 2$	M1
Obtain $x = \frac{1}{5}$	A1
State final answer $x > \frac{1}{5}$ only	A1
Alternative method for Question 2(b)	
Solve the linear inequality $3 - 2x < 3x + 2$, or corresponding equation	M1
Obtain critical value $x = \frac{1}{5}$	A1
State final answer $x > \frac{1}{5}$ only	A1
Alternative method for Question 2(b)	
Solve the quadratic inequality $(2x-3)^2 < (3x+2)^2$, or corresponding equation	M1
Obtain critical value $x = \frac{1}{5}$	A1
State final answer $x > \frac{1}{5}$ only	A1
	3

22) OCT 2022_9709_31 Q1

(a)	Show a recognisable sketch graph of $y = \lvert 2x+1 \rvert$	B1	 Ignore $y = 3x + 5$ if also drawn on the sketch.

b)	Find x-coordinate of intersection with $y = 3x + 5$	M1	
	Obtain $x = -\frac{6}{5}$	A1	
	State final answer $x < -\frac{6}{5}$ only	A1	Do not condone $\leqslant$ for $<$ in the final answer.
	Alternative method 1 for question 1(b)		
	Solve the linear inequality $3x+5 < -(2x+1)$, or corresponding equation	M1	Must solve the relevant equation.
	Obtain critical value $x = -\frac{6}{5}$	A1	Ignore -4 if seen.
	State final answer $x < -\frac{6}{5}$ only	A1	
	Alternative method 2 for question 1(b)		
	Solve the quadratic inequality $(3x+5)^2 < (2x+1)^2$, or corresponding equation	M1	$5x^2+26x+24<0$
	Obtain critical value $x = -\frac{6}{5}$	A1	Ignore -4 if seen.
	State final answer $x < -\frac{6}{5}$ only	A1	
		3	

23) OCT 2022_9709_32 Q2

(a)	Substitute $x = -\frac{3}{2}$ and equate result to zero	M1	Or divide by $2x+3$ and set constant remainder equal to zero. Or state $(2x^3-x^2+a)=(2x+3)(x^2+px+q)$, compare coefficients and solve for p or q.
	Obtain $a = 9$	A1	
		2	
(b)	Commence division by $(2x+3)$ reaching a partial quotient x^2+kx	*M1	The M1 is earned if inspection reaches an unknown factor: x^2+Bx+C and an equation in B and/or C, or an unknown factor Ax^2+Bx+3 and an equation in A and/or B.
	Obtain factorisation $(2x+3)(x^2-2x+3)$	A1	Allow if the correct quotient seen. Correct factors seen in **(a)** and quoted or used here scores M1A1.
	Show that x^2-2x+3 is always positive, or $2x^3-x^2+9$ only intersects the x-axis once	DM1	Must use their quadratic factor. SC If M0, allow B1 if state $x<-\frac{3}{2}$ and no error seen
	State final answer $x<-\frac{3}{2}$ from correct work	A1	
		4	