PURE MATHEMATICS -1

9709

(March, June and November series 2020 – 2023 With marking scheme)

BINOMIAL EXPANSION

EXERCISE -1

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1) SP-2020 _9709_1 Q6

(a) Find the coefficients of x^2 and x^3 in the expansion of $(2-x)^6$. [3]

(b) Hence find the coefficient of x^3 in the expansion of $(3x+1)(2-x)^6$. [2]

2) MARCH 2020_9709_12 Q6

The coefficient of $\frac{1}{x}$ in the expansion of $\left(2x+\frac{a}{x^2}\right)^5$ is 720.

(a) Find the possible values of the constant a. [3]

(b) Hence find the coefficient of $\frac{1}{x^7}$ in the expansion. [2]

3) MARCH 2021_9709_12 Q1

(a) Find the first three terms in the expansion, in ascending powers of x, of $(1+x)^5$. [1]

(b) Find the first three terms in the expansion, in ascending powers of x, of $(1-2x)^6$. [2]

(c) Hence find the coefficient of x^2 in the expansion of $(1+x)^5(1-2x)^6$. [2]

4) MARCH 2022_9709_12 Q3

Find the term independent of x in each of the following expansions.

(a) $\left(3x+\frac{2}{x^2}\right)^6$ [3]

(b) $\left(3x+\frac{2}{x^2}\right)^6(1-x^3)$ [3]

5) MARCH 2023_9709_12 Q6

In the expansion of $\left(\frac{x}{a}+\frac{a}{x^2}\right)^7$, it is given that

$$\frac{\text{the coefficient of } x^4}{\text{the coefficient of } x} = 3.$$

Find the possible values of the constant a. [6]

6) JUNE 2020_9709_11 Q2

The coefficient of $\frac{1}{x}$ in the expansion of $\left(kx+\frac{1}{x}\right)^5+\left(1-\frac{2}{x}\right)^8$ is 74.

Find the value of the positive constant k. [5]

7) JUNE 2020_9709_12 Q1

(a) Find the coefficient of x^2 in the expansion of $\left(x-\frac{2}{x}\right)^6$. [2]

(b) Find the coefficient of x^2 in the expansion of $(2+3x^2)\left(x-\frac{2}{x}\right)^6$. [3]

8) JUNE 2020_9709_13 Q4

(a) Expand $(1+a)^5$ in ascending powers of a up to and including the term in a^3. [1]

(b) Hence expand $[1+(x+x^2)]^5$ in ascending powers of x up to and including the term in x^3, simplifying your answer. [3]

9) JUNE 2021_9709_11 Q3

(a) Find the first three terms in the expansion of $(3-2x)^5$ in ascending powers of x. [3]

(b) Hence find the coefficient of x^2 in the expansion of $(4+x)^2(3-2x)^5$. [3]

10) JUNE 2021_9709_12 Q4

The coefficient of x in the expansion of $\left(4x+\frac{10}{x}\right)^3$ is p. The coefficient of $\frac{1}{x}$ in the expansion of $\left(2x+\frac{k}{x^2}\right)^5$ is q.

Given that $p=6q$, find the possible values of k. [5]

11) JUNE 2021_9709_13 Q7

(a) Write down the first four terms of the expansion, in ascending powers of x, of $(a-x)^6$. [2]

(b) Given that the coefficient of x^2 in the expansion of $\left(1+\frac{2}{ax}\right)(a-x)^6$ is -20, find in exact form the possible values of the constant a. [5]

12) JUNE 2022_9709_11 Q3

The coefficient of x^4 in the expansion of $\left(2x^2+\frac{k^2}{x}\right)^5$ is a. The coefficient of x^2 in the expansion of $(2kx-1)^4$ is b.

(a) Find a and b in terms of the constant k. [3]

(b) Given that $a+b=216$, find the possible values of k. [3]

13) JUNE 2022_9709_12 Q1

The coefficient of x^4 in the expansion of $(3+x)^5$ is equal to the coefficient of x^2 in the expansion of $\left(2x+\frac{a}{x}\right)^6$.

Find the value of the positive constant a. [4]

14) JUNE 2022_9709_13 Q1

The coefficient of x^3 in the expansion of $\left(p+\frac{1}{p}x\right)^4$ is 144.

Find the possible values of the constant p. [4]

15) JUNE 2023_9709_11 Q2

(a) Find the first three terms in the expansion, in ascending powers of x, of $(2+3x)^4$. [2]

(b) Find the first three terms in the expansion, in ascending powers of x, of $(1-2x)^5$. [2]

(c) Hence find the coefficient of x^2 in the expansion of $(2+3x)^4(1-2x)^5$. [2]

16) JUNE 2023_9709_12 Q 2

The coefficient of x^4 in the expansion of $(x+a)^6$ is p and the coefficient of x^2 in the expansion of $(ax+3)^4$ is q. It is given that $p+q=276$.

Find the possible values of the constant a. [4]

17) JUNE 2023_9709_13 Q3

(a) Give the complete expansion of $\left(x+\frac{2}{x}\right)^5$. [2]

(b) In the expansion of $(a+bx^2)\left(x+\frac{2}{x}\right)^5$, the coefficient of x is zero and the coefficient of $\frac{1}{x}$ is 80.

Find the values of the constants a and b. [4]

18) OCT 2020_9709_11 Q5

In the expansion of $\left(2x^2+\frac{a}{x}\right)^6$, the coefficients of x^6 and x^3 are equal.

(a) Find the value of the non-zero constant a. [4]

(b) Find the coefficient of x^6 in the expansion of $(1-x^3)\left(2x^2+\frac{a}{x}\right)^6$. [1]

19) OCT2020_9709_12 Q1

The coefficient of x^3 in the expansion of $(1+kx)(1-2x)^5$ is 20.

Find the value of the constant k. [4]

20) OCT 2020_9709_13 Q5

In the expansion of $(a+bx)^7$, where a and b are non-zero constants, the coefficients of x, x^2 and x^4 are the first, second and third terms respectively of a geometric progression.

Find the value of $\frac{a}{b}$. [5]

21) OCT 2021_9709_11 Q1

(a) Expand $\left(1-\frac{1}{2x}\right)^2$. [1]

(b) Find the first four terms in the expansion, in ascending powers of x, of $(1+2x)^6$. [2]

(c) Hence find the coefficient of x in the expansion of $\left(1-\frac{1}{2x}\right)^2(1+2x)^6$. [2]

22) OCT 2021_9709_12 Q8

(a) It is given that in the expansion of $(4 + 2x)(2 - ax)^5$, the coefficient of x^2 is -15.

Find the possible values of a. [4]

(b) It is given instead that in the expansion of $(4 + 2x)(2 - ax)^5$, the coefficient of x^2 is k. It is also given that there is only one value of a which leads to this value of k.

Find the values of k and a. [4]

23) OCT 2021_9709_13 Q2

(a) Find the first three terms, in ascending powers of x, in the expansion of $(1 + ax)^6$. [1]

(b) Given that the coefficient of x^2 in the expansion of $(1 - 3x)(1 + ax)^6$ is -3, find the possible values of the constant a. [4]

24) OCT 2022_9709_11 Q4

The coefficient of x^2 in the expansion of $\left(1 + \frac{2}{p}x\right)^5 + (1 + px)^6$ is 70.

Find the possible values of the constant p. [6]

25) OCT 2022_9709_13 Q3

(a) Find the first three terms in ascending powers of x of the expansion of $(1 + 2x)^5$. [2]

(b) Find the first three terms in ascending powers of x of the expansion of $(1 - 3x)^4$. [2]

(c) Hence find the coefficient of x^2 in the expansion of $(1 + 2x)^5(1 - 3x)^4$. [2]

MARKING SCHEME

1) SP-2020 _9709_1 Q6

(a)	Coefficient of x^2 is 240	1		B1	
	Coefficient of x^3 is $20 \times 8 \times (-1) = -160$	2		B2	B1 for +160
			3		
(b)	Product needs exactly 2 terms	1		M1	$3 \times$ their 240 + their -160
	$720 - 160 = 560$	1		A1FT	FT for candidate's answers
			2		

2) MARCH 2020_9709_12 Q6

(a)	$5C2\left[2(x)\right]^3\left[\frac{a}{(x^2)}\right]^2$	B1
	$10\times8\times a^2\left(\frac{x^3}{x^4}\right)=720\left(\frac{1}{x}\right)$	B1
	$a=\pm3$	B1
		3
(b)	$5C4\left[2(x)\right]\left[\frac{their\ a}{(x^2)}\right]^4$	B1
	810 identified	B1
		2

3) MARCH 2021_9709_12 Q1

a)	$1+5x+10x^2$	B1
		1
b)	$1-12x+60x^2$	B2, 1, 0
		2
c)	$(1+5x+10x^2)(1-12x+60x^2)$ leading to $60-60+10$	M1
	10	A1
		2

4) MARCH 2022_9709_12 Q3

(a)	${}^6C_2\times(3x)^4\left(\frac{2}{x^2}\right)^2$	B1
	$15\times3^4\times2^2$	B1
	4860	B1
		3
(b)	*Their* 4860 and one other relevant term	M1
	Other term = $6C3(3x)^3\left(\frac{2}{x^2}\right)^3$ or $6C3\times3^3\times2^3$ or 4320	A1
	[4860 – 4320 =] 540	A1
		3

5) MARCH 2023_9709_12 Q6

$7C1\left(\frac{x}{a}\right)^6\left(\frac{a}{x^2}\right)$ or $7C6\left(\frac{x}{a}\right)^6\left(\frac{a}{x^2}\right)$ $7C2\left(\frac{x}{a}\right)^5\left(\frac{a}{x^2}\right)^2$ or $7C5\left(\frac{x}{a}\right)^5\left(\frac{a}{x^2}\right)^2$	**B1 B1**
$\frac{\left(\frac{7}{a^5}\right)}{\left(\frac{21}{a^3}\right)}=3$	**M1**
	A1
$a^2=\frac{1}{9}$	**A1**
$a=\pm\frac{1}{3}$	**A1**
	6

6) JUNE 2020_9709_11 Q2

$\left(kx+\frac{1}{x}\right)^5+\left(1-\frac{2}{x}\right)^8$ Coefficient in $\left(kx+\frac{1}{x}\right)^5=10\times k^3$ **(B1 for 10. B1 for k^3)**	**B1B1**
Coefficient in $\left(1-\frac{2}{x}\right)^8=8\times -2$	**B2,1,0**
$10k^3-16=74\rightarrow k=3$	**B1**
	5

7) JUNE 2020_9709_12 Q1

(a)	$(2+3x)\left(x-\frac{2}{x}\right)^6$ Term in x^3 in $\left(x-\frac{2}{x}\right)^6=15x^4\times\left(\frac{-2}{x}\right)^2$	**B1**
	Coefficient = 60	**B1**
		2
(b)	Constant term in $\left(x-\frac{2}{x}\right)^6=20x^3\times\left(\frac{-2}{x}\right)^3$ (-160)	**B2, 1**
	Coefficient of x^2 in $(2+3x)\left(x-\frac{2}{x}\right)^6=120-480=-360$	**B1FT**
		3

8) JUNE 2020_9709_13 Q4

(a)	$1+5a+10a^2+10a^3+\ldots$	**B1**
		1
(b)	$1+5(x+x^2)+10(x+x^2)^2+10(x+x^2)^3+\ldots$ SOI	**M1**
	$1+5(x+x^2)+10(x^2+2x^3+\ldots)+10(x^3+\ldots)+\ldots$ SOI	**A1**
	$1+5x+15x^2+30x^3+\ldots$	**A1**
		3

9) JUNE 2021_9709_11 Q3

(a)	243	B1	
	$-810x$	B1	
	$+1080x^2$	B1	
		3	
(b)	$(4+x)^2 = 16 + 8x + x^2$	B1	
	Coefficient of x^2 is $16 \times 1080 + 8 \times (-810) + 243$	M1	Allow if at least 2 pairs used correctly
	11043	A1	Allow $11043x^2$
		3	

10) JUNE 2021_9709_12 Q4

[Coefficient of x or p =] 480	B1	SOI. Allow $480x$ even in an expansion.
$\left[\text{Term in } \frac{1}{x} \text{ or } q =\right][10\times](2x)^3\left(\frac{k}{x^2}\right)^2$	M1	Appropriate term identified and selected.
$[10 \times 2^3k^2 =]\ 80k^2$	A1	Allow $\frac{80k^2}{x}$
$p = 6q$ used ($480 = 6 \times 80k^2$ or $80 = 80k^2$)	M1	Correct link used for *their* coefficient of x and $\frac{1}{x}$ (p and q) with no x's.
$[k^2 = 1 \Rightarrow]\ k = \pm 1$	A1	A0 if a range of values given. Do not allow $\pm\sqrt{1}$.
	5	

11) JUNE 2021_9709_13 Q7

(a)	$(5-1)^2 + (11-5)^2 = 52$ or $\frac{11-5}{5-1}$	M1	For substituting (1,5) into circle equation or showing gradient $= \frac{3}{2}$.
	For both circle equation and gradient, and proving line is perpendicular and stating that A lies on the circle	A1	Clear reasoning.
	Alternative method for Question 7(a)		
	$(x-5)^2 + (y-11)^2 = 52$ and $y - 5 = -\frac{2}{3}(x-1)$	M1	Both equations seen and attempt to solve. May see $y = -\frac{2}{3}x + \frac{17}{3}$
	Solving simultaneously to obtain $(y-5)^2 = 0$ or $(x-1)^2 = 0 \Rightarrow 1$ root or tangent or discriminant $= 0 \Rightarrow 1$ root or tangent	A1	Clear reasoning.
	Alternative method for Question 7(a)		
	$\frac{dy}{dx} = \frac{10-2x}{2y-22} = \frac{10-2}{10-22}$	M1	Attempting implicit differentiation of circle equation and substitute $x = 1$ and $y = 5$.
	Showing gradient of circle at A is $-\frac{2}{3}$	A1	Clear reasoning.
		2	
(b)	Centre is $(-3, -1)$	B1 B1	B1 for each correct co-ordinate.
	Equation is $(x+3)^2 + (y+1)^2 = 52$	B1 FT	FT *their* centre, but not if either (1, 5) or (5, 11). Do not accept $\sqrt{52^2}$.
		3	

12) JUNE 2022_9709_11 Q3

(a)	x^4 term is $[10\times](2x^2)^3\left(\frac{k^2}{x}\right)^2$	M1	For selecting the term in x^4.
	$80k^4x^4 \Rightarrow a = 80k^4$	A1	For correct value of a. Allow $80k^4x^4$.
	$[x^2$ term is $[6\times](2kx)^2 \times 1 = 24k^2x^2 \Rightarrow]$ $b = 24k^2$	B1	For correct value of b. Allow $24k^2x^2$.
		3	
(b)	$80k^4+24k^2-216[=0]$ $\quad [\Rightarrow 10k^4+3k^2-27=0]$	M1	Forming a 3-term equation in k (all terms on one side) with *their* a and b and no x's.
	$(2k^2-3)(5k^2+9)$ $[=0]$ $[\Rightarrow k^2=\frac{3}{2}$ or $-\frac{9}{5}]$	M1	Attempt to solve 3-term quartic (or quadratic in another variable) by factorisation, formula or completing the square – see guidance.
	$[k]=\pm\sqrt{\frac{3}{2}}$	A1	OE e.g. $\pm\frac{\sqrt{6}}{2}$, $\pm\sqrt{1.5}$, AWRT ±1.22 Omission of $\pm$ A0. Additional answers A0. If M1 M0, SC **B1** can be awarded for correct final answer, max 2/3.
		3	

13) JUNE 2022_9709_12 Q1

$r=0.8$	B1	OE
$a=12.5$	B1	OE
$S_\infty = 12.5\div(1-0.8)$	M1	Using $\frac{a}{1-r}$ with '*their a*' and '*their r*' but $\lvert r\rvert$ must be <1.
$S_\infty=\frac{125}{2}, 62\frac{1}{2}$ or 62.5	A1	$\frac{12\frac{1}{2}}{\frac{1}{5}}$ or similar **does not** get A1.
	4	

14) JUNE 2022_9709_13 Q1

$4C1\times p\times\frac{1}{p^3}x^3$	B1	OE soi Can be seen in an expansion.
$\frac{4}{p^2}=144$	B1	OE Correct with correct power of p and only one p term.
$p=\pm\frac{1}{6}$	B1 B1	OE $\pm\frac{2}{12}$ etc. Allow ±0.167 for B1 B1. SC B1 for $\pm\sqrt{\frac{1}{36}}$ B1 only,
	4	

15) JUNE 2023_9709_11 Q2

(a)	$16+96x+216x^2$	B2, 1, 0	ISW (higher powers of x). Terms may be in any order or presented as a list.
		2	
(b)	$1-10x+40x^2$	B2, 1, 0	ISW (higher powers of x). Terms may be in any order or presented as a list.
		2	
(c)	$(16\times40)-(10\times96)+(1\times216)$	M1	*Their* 3 products which would give the term in x^2 (FT *their* values). Look for $640-960+216$.
	-104	A1	Condone $-104x^2$.
		2	

16) JUNE 2023_9709_12 Q 2

[Coefficient of $x^4 = p =$] $15a^2$	B1	May be seen in an expansion or with x^4.
[Coefficient of $x^2 = q =$] $54\,a^2$	B1	May be seen in an expansion or with x^2.
Equating *their* p + *their* q to 276 leading to an equation in a^2 only	M1	No x terms and no extra terms. If p and q are not identified then it needs to be clear from the expansion that the appropriate coefficients are being used. $69\,a^2 = 276$ implies the first 3 marks.
$a = \pm 2$	A1	CAO
	4	

17) JUNE 2023_9709_13 Q3

(a)	$x^5 + 10x^3 + 40x + \frac{80}{x} + \frac{80}{x^3} + \frac{32}{x^5}$ or $x^5 + 10x^3 + 40x + 80x^{-1} + 80x^{-3} + 32x^{-5}$	B2, 1, 0	B2, all terms correct, B1 5 terms correct. Terms must be simplified. Lists of terms allowed.
		2	
(b)	*their* $40 \times a + ($*their* coefficient of $x^{-1}) \times b = 0$	M1	Coefficients of a and b must be non-zero, allow x's so long as they are dealt with correctly.
	$($*their* coefficient of $x^{-1}) \times a + ($*their* coefficient of $x^{-3}) \times b = 80$	M1	Coefficients of a and b must be non-zero, allow x's as long as they are dealt with correctly.
	$a = 2 \quad b = -1$	A1 A1	Dependent on both M marks, may be seen without working.
		4	

18) OCT 2020_9709_11 Q5

(a)	$6C2 \times \left[2(x^2)\right]^4 \times \left[\frac{a}{(x)}\right]^2$, $6C3 \times \left[2(x^2)\right]^3 \times \left[\frac{a}{(x)}\right]^3$	B1 B1	SOI Can be seen in an expansion
	$15 \times 2^4 \times a^2 = 20 \times 2^3 \times a^3$	M1	SOI Terms must be from a correct series
	$a = \frac{15 \times 2^4}{20 \times 2^3} = \frac{3}{2}$	A1	OE
		4	
(b)	0	B1	
		1	

19) OCT2020_9709_12 Q1

Coefficient of x^3 in $(1-2x)^5$ is -80	B1	Can be seen in an expansion but must be simplified correctly.
Coefficient of x^2 in $(1-2x)^5$ is 40	B1	
Coefficient of x^3 in $(1+kx)(1-2x)^5$ is $40k - 80 = 20$	M1	Uses the relevant two terms to form an equation = 20 and solves to find k. Condone x^3 appearing in some terms if recovered.
$(k =)\frac{5}{2}$	A1	
	4	

20) OCT 2020_9709_13 Q5

$\left[7C1a^6b(x)\right]$, $\left[7C2a^5b^2(x^2)\right]$, $\left[7C4a^3b^4(x^4)\right]$	B2, 1, 0	SOI, can be seen in an expansion.
$\dfrac{7C2a^5b^2(x^2)}{7C1a^6b(x)}=\dfrac{7C4a^3b^4(x^4)}{7C2a^5b^2(x^2)} \rightarrow \dfrac{21a^5b^2}{7a^6b}=\dfrac{35a^3b^4}{21a^5b^2}$	M1 A1	M1 for a correct relationship OE (Ft from *their* 3 terms). For A1 binomial coefficients must be correct & evaluated.
$\dfrac{a}{b}=\dfrac{5}{9}$	A1	OE
	5	

21) OCT 2021_9709_11 Q1

(a)	$1-\dfrac{1}{x}+\dfrac{1}{4x^2}$	B1	OE. Multiply or use binomial expansion. Allow unsimplified.
		1	
(b)	$1+12x+60x^2+160x^3$	B2, 1, 0	Withhold 1 mark for each error; B2, 1, 0. ISW if more than 4 terms in the expansion.
		2	
(c)	$their(1\times12)+their(-1\times60)+their(\frac{1}{4}\times160)$	M1	Attempts at least 2 products where each product contains one term from each expansion.
	$[12-60+40=]\ -8$	A1	Allow $-8x$.
		2	

22) OCT 2021_9709_12 Q8

(a)	Terms required for x^2: $-5\times2^4\times ax+10\times2^3\times a^2x^2\left[=-80ax+80a^2x^2\right]$	B1	Can be seen as part of an expansion or in correct products.
	$2\times$ ($\pm$*their* coefficient of x) + $4\times$ ($\pm$*their* coefficient of x^2)	*M1	
	x^2 coefficient is $320a^2-160a=-15$ $\Rightarrow 64a^2-32a+3 \Rightarrow (8a-3)(8a-1)$	DM1	Forming a 3-term quadratic in a, with all terms on the same side or correctly setting up prior to completing the square and solving using factorisation, formula or completing the square. If factorising, factors must expand to give *their* coefficient of a^2.
	$a=\dfrac{1}{8}$ or $a=\dfrac{3}{8}$	A1	OE. **Special case:** If DM0 for solving quadratic, SC B1 can be awarded for correct final answers.
		4	
(b)	$320a^2-160a=k \Rightarrow 320a^2-160a-k[=0]$	M1	Forming a 3-term quadratic in a with all terms on the same side. Allow ± sign errors.
	Their b^2-4ac [= 0], $[160^2-4\times320\times(-k)=0]$	M1	Any use of discriminant on a 3-term quadratic.
	$k=-20$	A1	
	$a=\dfrac{1}{4}$	B1	Condone $a=\dfrac{1}{4}$ from $k=20$.
	Alternative method for question 8(b)		
	$320a^2-160a=k$ and divide by 320 $\left[a^2-\dfrac{a}{2}=\dfrac{k}{320}\right]$	M1	Allow ± sign errors.
	Attempt to complete the square $\left[\left(a-\dfrac{1}{4}\right)^2-\dfrac{1}{16}=\dfrac{k}{320}\right]$	M1	Must have $\left(a-\dfrac{1}{4}\right)^2$
	$a=\dfrac{1}{4}$	A1	
	$k=-20$	B1	

(b) cont'd	**Alternative method for question 8(b)**		
	$320a^2 - 160a = k$ and attempt to differentiate LHS $[640a - 160]$	**M1**	Allow ± sign errors.
	Setting *their* $(640a - 160) = 0$ and attempt to solve.	**M1**	
	$a = \frac{1}{4}$	**A1**	
	$k = -20$	**B1**	
		4	

23) OCT 2021_9709_13 Q2

(a)	$1 + 6ax + 15a^2x^2$	**B1**	Terms must be evaluated.
		1	
(b)	*their* $15a^2 \pm (3 \times$ *their* $6a)$	***M1**	Expect $15a^2 - 18a$.
	$15a^2 - 18a = -3$	**A1**	
	$(3)(a-1)(5a-1)\ [=0]$	**DM1**	Dependent on 3-term quadratic. Or solve using formula or completing the square.
	$a = 1,\ \frac{1}{5}$	**A1**	WWW. If DM0 awarded **SC B1** if both answers correct.
		4	

24) OCT 2022_9709_11 Q4

Coefficient of x^2 in $\left(1 + \frac{2}{p}x\right)^5$ is $10\left(\frac{2}{p}\right)^2 = \frac{10 \times 2^2}{p^2}\ \left[= \frac{40}{p^2}\right]$	**B1**	Accept with x^2 present. Must evaluate ${}^5C_2$
Coefficient of x^2 in $(1 + px)^6$ is $15(p)^2\ \left[= 15p^2\right]$	**B1**	Accept with x^2 present. Must evaluate ${}^6C_2$
$\frac{40}{p^2} + 15p^2 = 70$	***M1**	Forming an equation in p with *their* coefficients, the given 70, no x terms and no extra terms.
$15p^4 - 70p^2 + 40\ [=0]$ or $3p^4 - 14p^2 + 8\ [=0]$	**DM1**	Forming a 3-term equation in p (or another variable) with all terms on one side and *their* coefficients.
$[5](p^2 - 4)(3p^2 - 2)\ [=0]$ or $\frac{70 \pm \sqrt{70^2 - 4(15)(40)}}{30}$ or $\frac{14 \pm \sqrt{14^2 - 4(3)(8)}}{6}$	**DM1**	Attempt to solve 3-term quartic (or quadratic in another variable) by factorisation, formula or completing the square.
$p = \pm 2,\ \pm\sqrt{\frac{2}{3}}$	**A1**	OE e.g. $\pm\frac{\sqrt{6}}{3}$ or AWRT ± 0.816 If *M1 DM1 DM0, allow **SC B1** for 4 correct values.
	6	

25) OCT 2022_9709_13 Q3

(a)	$1+10x+40x^2$ May be part of a complete expansion	**B2, 1, 0**	1^5 must be simplified to 1, allow if the '1' is seen in a more complete expansion but not the final answer. Mis-reads not condoned in this question.
		2	
(b)	$1-12x+54x^2$ May be part of a complete expansion	**B2, 1, 0**	1^4 must be simplified to 1, allow if the '1' is seen in a more complete expansion but not the final answer. Mis-reads not condoned in this question.
		2	
(c)	$54-120+40$	**M1**	Forming exactly 3 products correctly using their terms.
	-26	**A1**	Allow $-26x^2$ If in a list with other terms it must be clear this is the required term otherwise A0.
		2	