AS and A level Mathematics Practice Paper – Binomial expansion – Mark scheme

Question	Scheme	Marks
1	$\left[(2-3x)^5\right] = \ldots \quad +\binom{5}{1}2^4(-3x)+\binom{5}{2}2^3(-3x)^2+..,\ \ \ldots\ldots$	M1
	$=32,\ -240x,\ +720x^2$	B1 A1 A1
		(4 marks)
2	$\left(3-\frac{1}{3}x\right)^5$	
	$3^5+{}^5C_1 3^4(-\frac{1}{3}x)+{}^5C_2 3^3(-\frac{1}{3}x)^2+{}^5C_3 3^2(-\frac{1}{3}x)^3\ldots$	
	First term of 243	B1
	$\left({}^5C_1\times\ldots\times x\right)+\left({}^5C_2\times\ldots\times x^2\right)+\left({}^5C_3\times\ldots\times x^3\right)\ldots$	M1
	$=(243\ ..\ )\ -\frac{405}{3}x+\frac{270}{9}x^2-\frac{90}{27}x^3\ldots$	A1
	$=(243\ ..\ )-135x+30x^2-\frac{10}{3}x^3..$	A1
		(4 marks)
3	$\left(2-\frac{x}{4}\right)^{10}$	
	$2^{10}+\underline{\underline{\binom{10}{1}}}2^9\left(-\frac{1}{4}\underline{\underline{x}}\right)+\underline{\underline{\binom{10}{2}}}2^8\left(-\frac{1}{4}\underline{\underline{x}}\right)^{\underline{\underline{2}}}+\ldots$	M1
	$=\underline{1024}-1280x+720x^2$	B1 A1 A1
		(4 marks)
4	$\left(1+\frac{3x}{2}\right)^8$	
	$1+12x$	B1
	$\ldots+\frac{8(7)}{2!}\left(\frac{3x}{2}\right)^2+\frac{8(7)(6)}{3!}\left(\frac{3x}{2}\right)^3+\ldots$	
	$\ldots+{}^8C_2\left(\frac{3x}{2}\right)^2+{}^8C_3\left(\frac{3x}{2}\right)^3+\ldots$	M1
	$\ldots+63x^2+189x^3+\ldots$	A1A1
		(4 marks)

Question	Scheme		Marks
5(a)	$\left\{(3+bx)^5\right\} = (3)^5 + \underline{{}^5C_1}(3)^4(b\underline{x}) + \underline{{}^5C_2}(3)^3\underline{(bx)^2} + \dots$ $= 243 + 405bx + 270b^2x^2 + \dots$	243 as a constant term seen $405bx$ $\left({}^5C_1 \times \dots \times x\right)$ or $\left({}^5C_2 \times \dots \times x^2\right)$ $270b^2x^2$ or $270(bx)^2$	B1 B1 M1 A1 **(4)**
5(b)	$\left\{2(\text{coeff } x) = \text{coeff } x^2\right\} \Rightarrow 2(405b) = 270b^2$ So, $\left\{b = \frac{810}{270} \Rightarrow\right\} b = 3$	Establishes an equation from their coefficients Condone 2 on the wrong side of the equation $b = 3$ (Ignore $b = 0$, if seen)	M1 A1 **(2)**
			(6 marks)
6(a)	$(1+\frac{x}{4})^8 = 1 + 2x + .., \quad \dots\dots$ $+\frac{8\times7}{2}(\frac{x}{4})^2 + \frac{8\times7\times6}{2\times3}(\frac{x}{4})^3,$ $= \quad +\frac{7}{4}x^2 + \frac{7}{8}x^3$ or $= \quad +1.75x^2 + 0.875x^3$		B1 M1 A1 A1 **(4)**
6(b)	States or implies that $x = 0.1$ Substitutes their value of x (provided it is <1) into series obtained in (a) i.e. 1 + 0.2 + 0.0175 + 0.000875, = 1.2184		B1 M1 A1 cao **(3)**
			(7 marks)

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Question	Scheme	Marks
7(a)	$(2-3x)^6 = 64 + ...$	B1
	$\{(2-3x)^6\} = (2)^6 + \underline{{}^6C_1}(2)^5(-3\underline{x}) + \underline{{}^6C_2}(2)^4(-3\underline{x})^2 + ...$	<u>M1</u>
	$= 64 - 576x + 2160x^2 + ...$	A1A1
		(4)
7(b)	$\left(1+\frac{x}{2}\right)(64-576x+...)$ or $\left(1+\frac{x}{2}\right)(64-576x+2160x^2+...)$ or	
	$\left(1+\frac{x}{2}\right)64-\left(1+\frac{x}{2}\right)576x$ or $\left(1+\frac{x}{2}\right)64-\left(1+\frac{x}{2}\right)576x+\left(1+\frac{x}{2}\right)2160x^2$	M1
	or $64+32x, -576x-288x^2,\ 2160x^2+1080x^3$ are fine.	
	$= 64 - 544x + 1872x^2 + ...$	A1A1
		(3)
		(7 marks)
8(a)	$\binom{40}{4} = \frac{40!}{4!b!}$; $(1+x)^n$ coefficients of x^4 and x^5 are p and q respectively	
	$b = 36$	B1
	Candidates should usually "identify" two terms as their p and q respectively	
		(1)
8(b)	Term 1: $\binom{40}{4}$ or ${}^{40}C_4$ or $\frac{40!}{4!36!}$ or $\frac{40(39)(38)(37)}{4!}$ or 91390	
	Term 2: $\binom{40}{5}$ or ${}^{40}C_5$ or $\frac{40!}{4!35!}$ or $\frac{40(39)(38)(37)(36)}{5!}$ or 658008	
	Hence, $\frac{q}{p} = \frac{658008}{91390}\left\{=\frac{36}{5}=7.2\right\}$	
	Any one of Term 1 or Term 2 correct (Ignore the label of p and/or q)	M1
	Both of them correct. (Ignore the label of p and/or q)	A1
	$\frac{658008}{91390}$ oe	A1 oe cso
		(3)
		(4 marks)

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Question	Scheme	Marks
9(a)	$(2-9x)^4 = 2^4 + {}^4C_1 2^3(-9x) + {}^4C_2 2^2(-9x)^2,$ (b) $f(x) = (1+kx)(2-9x)^4 = A - 232x + Bx^2$ First term of 16 in their final series At least one of $\left({}^4C_1 \times ... \times x\right)$ or $\left({}^4C_2 \times ... \times x^2\right)$ $= (16) - 288x + 1944x^2$	 B1 M1 A1 A1 **(4)**
9(b)	$A = "16"$	B1ft **(1)**
9(c)	$\left\{(1+kx)(2-9x)^4\right\} = (1+kx)\left(16 - 288x + \left\{1944x^2 + ...\right\}\right)$ x terms: $-288x + 16kx = -232x$ giving, $16k = 56 \Rightarrow \underline{k = \frac{7}{2}}$	M1 A1 **(2)**
9(d)	x^2 terms: $1944x^2 - 288kx^2$ So, $B = 1944 - 288\left(\frac{7}{2}\right);\ = 1944 - 1008 = 936$	 M1 A1 **(2)**
		(9 marks)

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	Source paper	Question number	New spec references	Question description	New AOs
1	C2 2012	1	4.1	Binomial expansion	1.1b
2	C2 2017	1	4.1	Binomial expansion	1.1b
3	C2 2015	1	4.1	Binomial expansion	1.1b
4	C2 June 2014R	1	4.1	Binomial expansion	1.1b
5	C2 2011	Q2	4.1	Binomial expansion	1.1b
6	C2 Jan 2012	Q3	4.1	Binomial expansion	1.1b, 2.2a
7	C2 2014	3	4.1	Binomial expansion	1.1b
8	C2 Jan 2011	5	4.1	Binomial expansion	1.1a, 1.1b
9	C2 2016	5	4.1	Binomial expansion	1.1b