Mark scheme

Binomial expansion

Additional Mathematics 0606 · Questions from Paper 1 and Paper 2

Total marks

57

MARKS FOR EACH QUESTION

1	2	3	4	5	6	7	8	9	10	Total
2	4	5	5	5	6	7	7	7	9	**57**

Question 1 [2]

1	$1+4e^{2x}+6e^{4x}+4e^{6x}+e^{8x}$	**B2**	mark final answer for **B2** **B1** for any 3 correct simplified terms in a sum or all 5 simplified terms listed but not summed or for a correct, simplified expansion that is not their final answer or **M1** for a correct unsimplified expansion e.g. $1+4e^{2x}+\frac{4\times3}{2}(e^{2x})^2+\frac{4\times3\times2}{6}(e^{2x})^3+(e^{2x})^4$ If 0 scored, **SC1** for a complete, correct, simplified expansion as final answer found by multiplying out the brackets

Question 2 [4]

2(a)	${}^{15}C_3k^3=-29120$ oe	**M1**	
	$k=-4$	**A1**	
2(b)	${}^{12}C_8\left(8y^2\right)^4\left(-\frac{1}{2y}\right)^8$ or ${}^{12}C_4\left(8y^2\right)^4\left(-\frac{1}{2y}\right)^8$	**M1**	
	7920	**A1**	

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Question 3 **[5]**

3 **(i)**	$(2-3x)^6 = 64 - 576x + 2160x^2$ isw	B1B1B1	
(ii)	$2160 - 2 \times 576 = 1008$	M1 A1	*their* final 2160 + 2 × *their* final –576

Question 4 **[5]**

4 **(i)**	$\left(x + \frac{2}{x^2}\right)^6 = x^6 + 12x^3 + 60...$	B3 [3]	B1 for each correct term
(ii)	Independent term = $(2 \times '60') + (-4 \times '12') = 72$	M1 A1 [2]	M1 for sum of 2 products (2 × their 60)+(–4 × their 12) A1 for 72

Question 5 **[5]**

5	$x^5 + 10x^3 + 40x + ...$	**3**	**M1** for attempt to expand $\left(x + \frac{2}{x}\right)^5$, with at least 2 correct terms **A1** for $10x^3$ **A1** for $40x$
	Term in x^2 : $(1 \times 40) - (3 \times 10)$	**M1**	For $(1 \times \textit{their } 40) \pm (3 \times \textit{their } 10)$
	10	**A1**	

Question 6 **[6]**

6 **(i)**	${}^6C_2\,(2^4)\,(px)^2$ or $\binom{6}{2} 2^4 (px)^2$	B1	Seen or implied, unsimplified
	$240p^2 = 60$ $p = \frac{1}{2}$	M1 A1 [3]	M1 for their coefficient of $x^2 = 60$ and attempt to solve
(ii)	coefficients of the terms needed	M1	M1 for realising that 2 terms are involved
	$(-1)\,{}^6C_1\,(2)^5\,p + (3 \times 60)$	B1	B1 for $(-1)\,{}^6C_1\,(2)^5\,p$ or $-192p$, using their p.
	= 84	A1 [3]	

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Question 7 [7]

7(i)	$64-48x^2+15x^4$	**B3**	**B1** for each correct term in final line of response
7(ii)	$\left(64-48x^2+15x^4\right)\left(\frac{1}{x^2}+2+x^2\right)$	**B1**	**B1**for $\frac{1}{x^2}+2+x^2$ oe
	at least two correctly obtained products leading to terms in x^2	**M1**	
	Term in x^2 : $64+15-96$	**A1**	**FT** for correct evaluation of *their* 64 + (2 × *their*–48) + *their* 15
	$=-17$	**A1**	

Question 8 [7]

8	$a^5+5a^4bx+10a^3b^2x^2$	**2**	**B1** for powers or for coefficients
	$a^5+\left(a^5+5a^4b\right)x+\left(10a^3b^2+5a^4b\right)x^2$	**2**	**M1** for multiplying to obtain 5 terms **A1** for all correct
	$a^5=32\rightarrow a=2$	**A1**	
	$32+80b=-208\rightarrow b=-3$	**A1**	
	$10\times8\times9+5\times16\times-3=c\rightarrow c=480$	**A1**	

Question 9 [7]

9(a)	$x=\sqrt[3]{\frac{28}{56}}$ oe, nfww, isw	**3**	**B2** for $28x^{10}$ and $56x^{13}$ OR $[x^8](28x^2)$ and $[x^8](56x^5)$ or **B1** for $28x^{10}$ or $56x^{13}$ OR $[x^8](28x^2)$ or $[x^8](56x^5)$
9(b)(i)	$n = 10$	**2**	**B1** for the correct term in any form e.g. ${}^nC_5x^{n-5}\left(\frac{2}{x}\right)^5$ or for $n-5=5$ oe, soi
9(b)(ii)	8064	**2**	**B1** for ${}^{10}C_5\times2^5$ oe e.g. 252 × 32

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Question 10 **[9]**

10	$n = 6$ stated; nfww	**B2**	**B1** for first term: $\left(3x^2\right)^n$ or $\left(3x^2\right)^6$ soi
	$-6\left(3x^2\right)^5 a + 2\left(729x^{10}\right) = 972x^{10}$ oe and $\frac{6\times 5\left(3x^2\right)^4(-a)^2}{2} + 6\left(3x^2\right)^5 \times \frac{2}{x^2}(-a) + 729x^8 = bx^8$ oe	**B3**	**B2** for one correct equation **OR** **B1** for second term: $n(-a)\left(3x^2\right)^{n-1}$ or $6(-a)\left(3x^2\right)^5$ or $-1458ax^{10}$ soi **B1** for third term: $\frac{n(n-1)(-a)^2\left(3x^2\right)^{n-2}}{2}$ or $\frac{6(5)(-a)^2\left(3x^2\right)^4}{2}$ or $1215a^2x^8$ soi **B1** for $1 \quad [+] \quad \frac{2}{x^2} \quad [+] \quad \frac{1}{x^4}$ soi
	$a = \frac{1}{3}$	**B2**	**B1** for $-1458a + 1458 = 972$ soi
	$b = -108$	**B2**	**B1** for $1215a^2 - 2916a + 729$ soi

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