AS-Level

Topic : Binomial Theorem

May 2013-May 2025

Answer

Question 1

(i)	$(2+ax)^5 = 32 + 80ax + 80a^2x^2$	$3 \times$ B1	[3]	B1 for each term.
(ii)	$\times (1+2x)$ $240 = 80a^2 + 160a$ $\rightarrow a = 1$ or $a = -3$.	M1 DM1A1	[3]	Realises need to consider 2 terms. Solution of 3-term quadratic.

Question 2

$$\left(2x - \frac{1}{2x}\right)^6$$

(i)	Coeff of $x^2 = 15 \times 16 \times (-\frac{1}{2})^2 = 60$	B1 B1	[2]	B1 for 2/3 parts. B1
(ii)	Constant term is $20 \times 8x^3 \times (-1 \div 8x^3)$ $\times (1 + x^2)$ needs to consider 2 terms $\rightarrow \ 60 - 20 = 40$	B1 M1 A1	[3]	B1 unsimplified Needs to consider the constant term

Question 3

(i)	$1 - 6px \quad +15p^2x^2$	B1B1	[2]	Simplificn of nCr can be scored in (ii)
(ii)	$15p^2 \times 1 - 6p \times -1$ $3p(5p+2) = 0$ $p = -\dfrac{2}{5}$ oe	M1 DM1 A1	[3]	Obtain & attempt to solve quadratic Allow $p = 0$ in addition

Question 4

(i)	$81 \ (x^8)$	B1	[1]	
(ii)	$10 \times 3^3 \ (x^8)$ soi leading to their answer $270 \ (x^8)$	B1B1 B1	[3]	B1 for 10, 5C2 or 5C3. B1 for 3^3. But must be multiplied.
(iii)	k × (i) 405 soi + (ii) $675 \ (x^8)$	M1 A1 DM1 A1	[4]	$k \neq 1,0$

Question 5

(i) $64 + 576x + 2160x^2$ ⎪ B1B1B1 ⎪ Can score in (ii)
⎪ **[3]** ⎪

(ii) $576a(x^2) + 2160(x^2) = 0$ ⎪ M1

$a = -\dfrac{2160}{576}$ oe (eg $-\dfrac{15}{4}$) or -3.75 ⎪ A1

⎪ **[2]** ⎪

Question 6

$\left(x^2 - \dfrac{2}{x}\right)^5$

Term in x is $10 \times (x^2)^2 \times \left(\dfrac{-2}{x}\right)^3$ ⎪ B1 B1 ⎪ B1 10 or $^5C_2$ or $^5C_3$, B1 $\left(\dfrac{-2}{x}\right)^3$

Coefficient $= -80(x)$ ⎪ B1 ⎪ co Must be identified

⎪ **[3]** ⎪

Question 7

$\left(1 + x^2\right)\left(\dfrac{x}{2} - \dfrac{4}{x}\right)^6$.

Term in $x^2 = 15 \times \frac{1}{16} \times (-4)^2 = 15$ ⎪ B1 B1 ⎪ B1 unsimplified. B1 15.

Constant term $= 20 \times \frac{1}{8} \times (-4)^3 = -160$ ⎪ B1 B1 ⎪ B1 unsimplified. B1 -160

Coefficient of $x^2 = -145$ ⎪ B1√ ⎪ Uses 2 terms. √ on previous answers

⎪ **[5]** ⎪

Question 8

$[^8C_6 \text{ or } 28] \times [16 \text{ or } 4^2](x^6) \times \left[\dfrac{1}{(64 \text{ or } 2^6)(x^6)}\right]$ ⎪ B1B1B1 ⎪ Seen in expansion ok. Allow $^8C_2$

7 ⎪ B1 ⎪ Identified as answer

⎪ **[4]** ⎪

Question 9

$\left(15 \text{ or } ^{16}C_2\right) \times 2^4 \times (ax)^2,\ \left(20 \text{ or } ^6C_3\right) \times 2^3 \times (ax)^3$ ⎪ B1B1

$a = \dfrac{15 \times 2^4}{20 \times 2^3} = \dfrac{3}{2}$ ⎪ M1A1 ⎪ $240a = 160a$ is M0

⎪ **[4]** ⎪

Question 10

(i) $(1+x)^5 = 1 + 5x + 10x^2$ ⎪ B2,1 ⎪ Loses 1 for each error

⎪ **[2]** ⎪

(ii) $(1 + px + x^2)^5$

$(1+) \, 5(px + x^2) + 10(px + x^2)^2$ ⎪ M1 ⎪ Replace x by $(px + x^2)$ in their expansion

Coeff of $x^2 = 5 + 10p^2$ ⎪ DM1 ⎪ Considers 2 terms

$= 95 \rightarrow p = 3$ ⎪ A1 ⎪ co – no penalty for ± 3

⎪ **[3]** ⎪

Question 11

$$^7C_1 \times 2^6 \times a \;(=)\; {}^7C_2 \times 2^5 \times a^2 \quad \text{soi}$$

$$a = \left(\frac{7 \times 2^6}{21 \times 2^5}\right) = \frac{2}{3} \qquad \text{oe}$$

B2, 1, 0	Treat the same error in each expression as a single error
B1 [3]	

Question 12

(i)	$a^5 - 5a^4x + 10a^3x^2 - 10a^2x^3 \; + ...$	**B2,1,0** [2]	Ok full expansion (ignore extra terms) Descending: Ok if full expansion but max B1 for 4 terms
(ii)	$(1-ax)(..10a^3x^2 - 10a^2x^3..) = (x^3)(-10a^4 - 10a^2)$	**M1**	Attempt to find coeff. of x^3 from 2 terms
	$-10a^4 - 10a^2 = -200$	**A1√**	Ft from *their* $10a^3, -10a^2$ from part (i)
	$a^2 = 4 \quad$ ignore $a^2 = -5$	**M1**	Attempt soln. for a^2 from 3-term quad. in a^2
	$a = \pm 2 \quad$ cao	**A1** [4]	Ignore any imaginary solutions

Question 13

(i)	$(2-x)^6$ Coeff of x^2 is 240 Coeff of x^3 is $-20 \times 8 = -160$	**B1** **B2,1** [3]	co B1 for +160
(ii)	$(3x+1)(2-x)^6$ Product needs exactly 2 terms $\rightarrow 720 - 160 = 560$	**M1** **A1√** [2]	$3 \times$ their 240 + their -160 √ for candidate's answers.

Question 14

$(1-x)^2 (1+2x)^6.$

(i) (a)	$(1-x)^6 = 1 - 6x + 15x^2$	**B2,1** [2]	-1 each error
(b)	$(1+2x)^6 = 1 + 12x + 60x^2$	**B2,1** [2]	-1 each error **SC** B1 only, in each part, for all 3 correct descending powers **SC** only one penalty for omission of the '1' in each expansion
(ii)	Product of (a) and (b) with >1 term $\rightarrow 60 - 72 + 15 = 3$	**M1** **DM1A1** [3]	Must be 2 or more products M1 exactly 3 products. cao, condone $3x^2$

Question 15

$[7C2] \times \left[\left(\dfrac{x}{3}\right)^5\right] \times \left[\left(\dfrac{9}{x^2}\right)^2\right]$ soi	**B2,1,0**	Seen
$21 \times \dfrac{1}{3^5}(x^5) \times 81\left(\dfrac{1}{x^4}\right)$ soi	**B1**	Identified as required term
7	**B1** [4]	Accept $7x$

Question 16

$(x + 2k)^7$		
Term in $x^5 = 21 \times 4k^2 = 84k^2$	**B1**	
Term in $x^4 = 35 \times 8k^3 = 280k^3$	**B1**	
Equate and solve $\rightarrow k = 0.3$ or $\dfrac{3}{10}$	**M1 A1** [4]	Correct method to obtain k.

Question 17

$(a+x)^5 = a^5 + {}^5C_1 a^4 x + {}^5C_2 a^3 x^2 + \ldots$ soi	**M1**	Ignore subsequent terms
$\left(-\dfrac{2}{a} \times (\textit{their } 5a^4) + (\textit{their } 10a^3)\right)(x^2)$	**M1**	
0	**A1** [3]	AG

Question 18

(i)	$80(x^4),\ -32(x^5)$	**B1B1** [2]	Fully simplified
(ii)	$(-32 + 80p)(x^5) = 0$ $p = 2/5$ or $32/80$ oe	**M1** **A1**√ [2]	Attempt to mult. relevant terms & put $= 0$

Question 19

$$\left|\, 5C2\left(\frac{1}{x}\right)^3\left(3x^2\right)^2 \right.$$

B1   Can be seen in expansion

$$10(\times 1)\times 3^2$$

B1   Identified as leading to answer

$$90\,(x)$$

B1

[3]

Question 20

(i) $\left(x-\dfrac{2}{x}\right)^6$

Term is $_6C_3\times(-2)^3=(-)160$ **B1** ± 160 seen anywhere

-160 **B1**

[2]

(ii) $\left(2+\dfrac{3}{x^2}\right)\left(x-\dfrac{2}{x}\right)^6$

Term in $x^2=\,_6C_2(-2)^2\,x^2$ **B1** ± 60 seen anywhere

$=60\,(x^2)$ **B1**

Term independent of x:

$=2\times(\text{their}-160)+3\times(\text{their }60)$ **M1**   Using 2 products correctly

-140 **A1**

[4]

Question 21

$\left(x-\dfrac{3}{2x}\right)^6$

Term is $^6C_3\times x^3\times\left(\dfrac{-3}{2x}\right)^3$ **B1 B1**   B1 for Bin coeff. B1 for rest.

$\rightarrow -67.5$ oe   **B1**

[3]

Question 22

$(+/-)20\times 3^3\left(x^3\right),\quad 10a^3\left(x^3\right)$ soi   **B1B1**   Each term can include x^3

$-540+10a^3=100$ oe   **M1**   Must have 3 terms and include a^3 and 100

$a=4$ **A1**

[4]

Question 23

Term in $x = \dfrac{nx}{2}$	**B1**	Could be implied by use of a numerical n.
$(3-2x)(1+\dfrac{nx}{2}+...) \rightarrow 7 = \dfrac{3n}{2} - 2$	**M1**	(Their 2 terms in x) $= 7$
$\rightarrow n = 6$	**A1**	
Term in $x^2 = \dfrac{n(n-1)}{2}\left(\dfrac{x}{2}\right)^2$	**B1**	May be implied by (their n) $\times$ (their $n-1$) $\div$ 8.
Coefficient of $x^2 = \dfrac{3n(n-1)}{8} - \dfrac{2n}{2}$	**M1**	Considers 2 terms in x^2.
$= \dfrac{21}{4}$	**A1** [6]	aef

Question 24

$8C6\,(2x)^6\left(\dfrac{1}{2x^3}\right)^2$ soi	**B1**	May be seen within a number of terms
$28 \times 64 \times \dfrac{1}{4}$ oe (powers and factorials evaluated)	**B2,1,0**	May be seen within a number of terms
448	**B1** [4]	Identified as answer

Question 25

$5C2\left(\dfrac{1}{ax}\right)^3(2ax^2)^2$ soi	**B1**	Seen or implied. Can be part of an expansion.
$10 \times \dfrac{1}{a^3} \times 4a^2 = 5$ soi	**M1A1**	M1 for identifying relevant term and equating to 5, all correct. Ignore extra x
$a = 8$ cao	**A1**	
Total:	**4**	

Question 26

$7C1 \times 2^6 \times a(x),\ 7C2 \times 2^5 \times [a(x)]^2$	**B1 B1**	SOI Can be part of expansion. Condone ax^2 only if followed by a^2.
		ALT $\ 2^7[1 + ax/2]^7 \rightarrow 7C1[a(x)/2] = 7C2[a(x)/2]^2$
$a = \dfrac{7 \times 2^6}{21 \times 2^5} = \dfrac{2}{3}$	**B1**	Ignore extra soln $a = 0$. Allow $a = 0.667$. Do not allow an extra x in the answer
Total:	**3**	

Question 27

(i)	Coefficient of $x = 80(x)$	**B2**	Correct value must be selected for both marks. SR +80 seen in an expansion gets **B1** or −80 gets **B1** <u>if selected.</u>
	Total:	**2**	
(ii)	Coefficient of $\dfrac{1}{x} = -40\left(\dfrac{1}{x}\right)$	**B2**	Correct value soi in (ii), if powers unsimplified only allow if selected. SR +40 soi in (ii) gets **B1**.
	Coefficient of $x = (1 \times \text{their } 80) + (3 \times \text{their} -40) = -40(x)$	**M1 A1**	Links the appropriate 2 terms only for **M1**.
	Total:	**4**	

Question 28

$(3-2x)^6$			
Coeff of $x^2 = 3^4 \times (-2)^2 \times {}_6C_2 = a$		**B3,2,1**	Mark unsimplified forms. −1 each independent error but powers
Coeff of $x^3 = 3^3 \times (-2)^3 \times {}_6C_3 = b$			must be correct. Ignore any 'x' present.
$\dfrac{a}{b} = -\dfrac{9}{8}$		**B1**	OE. Negative sign must appear before or in the numerator
	Total:	**4**	

Question 29

(i)	$6C3\left(\dfrac{2}{x}\right)^3(-3x)^3$ SOI also allowed if seen in an expansion	**M1**	Both x's can be missing.
	-4320 Identified as answer	**A1**	Cannot be earned retrospectively in **(ii)**.
		2	
(ii)	$6C2\left(\dfrac{2}{x}\right)^4\left[(-)3x\right]^2$ SOI clearly identified as critical term	**M1**	Both x's and minus sign can be missing.
	$15a \times 16 \times 9 - their\, 4320\,(=0)$	**A1 FT**	FT on *their* 4320.
	$a = 2$	**A1**	
		3	

Question 30

EITHER: Term is $\;{}^9C_3 \times 2^6 \times (-¼)^3$	**(B1, B1, B1)**	OE
OR1: $\left(\dfrac{8x^3-1}{4x^2}\right)^9 = \left(\dfrac{1}{4x^2}\right)^9(8x^3-1)^9 \; or \; -\left(\dfrac{1}{4x^2}\right)^9(1-8x^3)^9$		
Term is $-\dfrac{1}{4^9} \times {}^9C_3 \times 8^6$	**(B1, B1, B1)**	OE
OR2: $(2x)^9\left(1-\dfrac{1}{8x^3}\right)^9$		
Term is $2^9 \times {}^9C_3 \times \left(-\dfrac{1}{8}\right)^3$	**(B1, B1, B1)**	OE
Selected term, which must be independent of $x = -84$	**B1**	
	4	

Question 31

(i)	${}^7C_2\left(+/-2x\right)^2$ or ${}^7C_3(-2x)^3$	**M1**	SOI, Allow for either term correct. Allow + or − inside first bracket.
	$84\,(x^2)$, $-280(x^3)$	**A1A1**	
		3	
(ii)	$2 \times (their-280) + 5 \times (their\,84)$ only	**M1**	
	-140	**A1**	
		2	

Question 32

$_5C_3 \, x^2 \left(\dfrac{-2}{x}\right)^3$ SOI	**B2,1,0**	-80 www scores B3. Accept $_5C_2$.
-80 Accept $\dfrac{-80}{x}$	**B1**	$+80$ without clear working scores SCB1
	3	

Question 33

Coefficient of x^2 in $\left(2 + \dfrac{x}{2}\right)^6$ is $_6C_2 \times 2^4 \times (\frac{1}{2})^2 \, (x^2) \, (= 60)$	**B2,1,0**	3 things wanted -1 each incorrect component, must be multiplied together. Allow $_6C_4$, $\begin{pmatrix} 6 \\ 4 \end{pmatrix}$ and factorial equivalents. Marks can be awarded for correct term in an expansion.
Coefficient of x^2 in $(a+x)^5$ is $_5C_2 \times a^3 \, (x^2) \, (= 10a^3)$	**B1**	Marks can be awarded for correct term in an expansion.
$\rightarrow 60 + 10a^3 = 330$	**M1**	Forms an equation 'their 60' + 'their $10a^3$' = 330, OK with x^2 in all three terms initially. This can be recovered by a correct answer.
$a = 3$	**A1**	Condone ±3 as long as $+3$ is selected.
	5	

Question 34

(i)	$(1-2x)^5 = 1 - 10x + 40x^2$ (no penalty for extra terms)	**B2,1**	Loses a mark for each incorrect term. Treat $-32x^5 + 80x^4 - 80x^3$ as MR -1
		2	
(ii)	$\rightarrow (1 + ax + 2x^2)(1 - 10x + 40x^2)$		
	3 terms in $x^2 \rightarrow 40 - 10a + 2$	**M1 A1FT**	Selects 3 terms in x^2. FT from **(i)**
	Equate with $12 \rightarrow a = 3$	**A1**	CAO
		3	

Question 35

7C5 $x^2(-2/x)^5$	soi	**B1**	Can appear in an expansion. Allow 7C2
21×-32	soi	**B1**	Identified. Allow $(21x^2) \times (-32 \, x^{-5})$. Implied by correct answer
-672		**B1**	Allow $\dfrac{-672}{x^3}$. If 0/3 scored, 672 scores SCB1
		3	

Question 36

For a correctly selected term in $\dfrac{1}{x^2}$: $(3x)^4$ or 3^4	**B1**	Components of coefficient added together 0/4 B1 expect 81
$\times \left(\dfrac{2}{3x^2}\right)^3$ or $(2/3)^3$	**B1**	B1 expect 8/27
$\times \, _7C_3$ or $_7C_4$	**B1**	B1 expect 35
$\rightarrow \mathbf{840}$ or $\dfrac{840}{x^2}$	**B1**	All of the first three marks can be scored if the correct term is seen in an expansion **and it is selected** but then wrongly simplified.
		SC: A completely correct unsimplified term seen in an expansion but not correctly selected can be awarded B2.
	4	

Question 37

$5C3\left[(-)(px)^3\right]$ soi	**B1**	Can be part of expansion. Condone omission of $-$ sign
$(-1)10p^3 = -2160$ then $\div$ and cube root	**M1**	Condone omission of $-$ sign.
$p = 6$	**A1**	
	3	

Question 38

(i)	$\dfrac{-5}{x} + \dfrac{5}{8x^3} - \dfrac{1}{32x^5}$ (or $-5x^{-1} + \dfrac{5}{8}x^{-3} - \dfrac{1}{32}x^{-5}$)	**B1B1B1**	B1 for each correct term SCB1 for both $\dfrac{+5}{x}$ & $\dfrac{+1}{32x^5}$
		3	
(ii)	$1 \times 20 + 4 \times their\,(-5) = 0$	**M1A1**	Must be from exactly 2 terms SCB1 for $20 + 20 = 40$
		2	

Question 39

For $\left(\dfrac{2}{x} - 3x\right)^5$ term in x is 10 or 5C3 or $5C2 \times \left(\dfrac{2}{x}\right)^2 \times (-3x)^3$ or $\left(\dfrac{2}{x}\right)^5 \dfrac{5.4.3}{3!}\left(-\dfrac{3}{2}x^2\right)^3$ or $(-3x)^5 \dfrac{5.4}{2!}\left(\dfrac{2}{3x^2}\right)^2$	**B2,1**	3 elements required. -1 for each error with or without x's. Can be seen in an expansion.
-1080 identified	**B1**	Allow $-1080x$ Allow if expansion stops at this term. Allow from expanding brackets.
	3	

Question 40

(i)	Ind term $= (2x)^3 \times \left(\dfrac{k}{x}\right)^3 \times {}_6C_3$	**B2,1,0**	Term must be isolated
	$= 540 \rightarrow k = 1\frac{1}{2}$	**B1**	
		3	
(ii)	Term, in x^2 is $(2x)^4 \times \left(\dfrac{k}{x}\right)^2 \times {}_6C_2$	**B1**	All correct – even if k incorrect.
	$15 \times 16 \times k^2 = 540$ (or $540\,x^2$)	**B1**	**FT** For $240k^2$ or $240\,k^2x^2$
		2	

Question 41

(i)	$1 + 6y + 15y^2$	**B1**	CAO
		1	
(ii)	$1 + 6\left(px - 2x^2\right) + 15\left(px - 2x^2\right)^2$	**M1**	SOI. Allow $6C1 \times 1^5\left(px - 2x^2\right)$, $6C2 \times 1^4\left(px - 2x^2\right)^2$
	$\left(15p^2 - 12\right)(x^2) = 48(x^2)$	**A1**	1 term from each bracket and equate to 48
	$p = 2$	**A1**	**SC:** A1 $p = 4$ from $15p - 12 = 48$
		3	

Question 42

$\dfrac{6x}{2}$, $15 \times \dfrac{x^2}{4}$	**B1 B1**	OE In or from a correct expansion. Can be implied by correct equation.
$\times (4 + ax) \rightarrow 3a + 15 = 3$	**M1**	2 terms in x^2 equated to 3 or $3x^2$. Condone x^2 on one side only.
$a = -4$	**A1**	CAO
	4	

Question 43

$6C2 \times (2x)^4 \times \dfrac{1}{(4x^2)^2}$	**B1**	SOI **SC:** Condone errors in $(4^{-1})^2$ evaluation or interpretation for B1 only
$15 \times 2^4 \times \dfrac{1}{4^2}$	**B1**	Identified as required term.
15	**B1**	
	3	

Question 44

(a)	$5C2 \left[2(x)\right]^3 \left[\dfrac{a}{(x^2)}\right]^2$	**B1**	SOI Can include correct x's
	$10 \times 8 \times a^2 \left(\dfrac{x^3}{x^4}\right) = 720\left(\dfrac{1}{x}\right)$	**B1**	SOI Can include correct x's
	$a = \pm 3$	**B1**	
		3	
(b)	$5C4 \left[2(x)\right] \left[\dfrac{\textit{their } a}{(x^2)}\right]^4$	**B1**	SOI *Their a* can be just <u>one</u> of their values (e.g. just 3). Can gain mark from within an expansion but must use *their* value of a
	810 identified	**B1**	Allow with x^{-7}
		2	

Question 45

(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

Question 46

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

Question 47

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

Question 48

$\left[7C1a^6b(x)\right]$, $\left[7C2a^5b^2\left(x^2\right)\right]$, $\left[7C4a^3b^4\left(x^4\right)\right]$	**B2, 1, 0**	SOI, can be seen in an expansion.
$\dfrac{7C2a^5b^2\left(x^2\right)}{7C1a^6b(x)} = \dfrac{7C4a^3b^4\left(x^4\right)}{7C2a^5b^2\left(x^2\right)} \rightarrow \dfrac{21a^5b^2}{7a^6b} = \dfrac{35a^3b^4}{21a^5b^2}$	**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	

Question 49

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.
$(k =) \dfrac{5}{2}$	**A1**	
	4	

Question 50

(a)	$6C2 \times \left[2\left(x^2\right)\right]^4 \times \left[\dfrac{a}{(x)}\right]^2$, $6C3 \times \left[2\left(x^2\right)\right]^3 \times \left[\dfrac{a}{(x)}\right]^3$	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
	$a = \dfrac{15 \times 2^4}{20 \times 2^3} = \dfrac{3}{2}$	A1	OE
		4	
(b)	0	B1	
		1	

Question 51

(a)	$1 + 5x + 10x^2$	B1	
		1	
(b)	$1 - 12x + 60x^2$	B2, 1, 0	B2 all correct, B1 for two correct components.
		2	
(c)	$\left(1 + 5x + 10x^2\right)\left(1 - 12x + 60x^2\right)$ leading to $60 - 60 + 10$	M1	3 products required
	10	A1	Allow $10x^2$
		2	

Question 52

(a)	$(a-x)^6 = a^6 - 6a^5 x + 15a^4 x^2 - 20a^3 x^3 + \dots$	B2, 1, 0	Allow extra terms. Terms may be listed. Allow $a^6 x^0$.
		2	
(b)	$\left(1 + \dfrac{2}{ax}\right)\left(\dots 15a^4 x^2 - 20a^3 x^3 + \dots\right)$ leading to $\left[x^2\right]\left(15a^4 - 40a^2\right)$	M1	Attempting to find 2 terms in x^2
	$15a^4 - 40a^2 = -20$ leading to $15a^4 - 40a^2 + 20 [= 0]$	A1	Terms on one side of the equation
	$\left(5a^2 - 10\right)\left(3a^2 - 2\right) \ [= 0]$	M1	OE. M1 for attempted factorisation or solving for a^2 or $u\ (=a^2)$ using e.g. formula or completing the square
	$a = \pm\sqrt{2}, \ \pm\sqrt{\dfrac{2}{3}}$	B1 B1	OE exact form only If B0B0 scored then **SC B1** for $\sqrt{2}, \sqrt{\dfrac{2}{3}}$ WWW or $\pm 1.41, \pm 0,816$ WWW
		5	

Question 53

[Coefficient of x or p =] 480	B1	SOI. Allow $480x$ even in an expansion.
$\left[\text{Term in }\dfrac{1}{x}\text{ or }q=\right]\left[10\times\right](2x)^3\left(\dfrac{k}{x^2}\right)^2$	M1	Appropriate term identified and selected.
$[10\times2^3k^2=]\ 80k^2$	A1	Allow $\dfrac{80k^2}{x}$
$p=6q$ used ($480=6\times80k^2$ or $80=80k^2$)	M1	Correct link used for *their* coefficient of x and $\dfrac{1}{x}$ (p and q) with no x's.
$[k^2=1\Rightarrow]\ k=\pm1$	A1	A0 if a range of values given. Do not allow $\pm\sqrt{1}$.
	5	

Question 54

(a)	243	B1	
	$-810x$	B1	
	$+1080x^2$	B1	
		3	
(b)	$(4+x)^2=16+8x+x^2$	B1	
	Coefficient of x^2 is $16\times1080+8\times(-810)+243$	M1	Allow if at least 2 pairs used correctly
	11043	A1	Allow $11043x^2$
		3	

Question 55

(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.
	$a=1,\ \dfrac{1}{5}$	A1	WWW. If DM0 awarded **SC B1** if both answers correct.
		4	

Question 56

(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)	$320a^2-160a=k\Rightarrow320a^2-160a-k[=0]$	**M1**	Forming a 3-term quadratic in a with all terms on the same side. Allow $\pm$ 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 $\pm$ 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**	

Question 57

(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)	$their\,(1\times12)+their\,(-1\times60)+their\,(\tfrac{1}{4}\times160)$	**M1**	Attempts at least 2 products where each product contains one term from each expansion.
	$[12-60+40=]-8$	**A1**	Allow $-8x$.
		2	

Question 58

(a)	$^6C_2 \times (3x)^4 \left(\dfrac{2}{x^2}\right)^2$	**B1**	Can be seen within an expansion.
	$15 \times 3^4 \times 2^2$	**B1**	Identified. Powers must be correct.
	4860	**B1**	Without any power of x
		3	
(b)	*Their* 4860 and one other relevant term	**M1**	Using *their* 4860 and an attempt to find a term in x^{-3}
	Other term $= 6C3(3x)^3 \left(\dfrac{2}{x^2}\right)^3$ or $6C3 \times 3^3 \times 2^3$ or 4320	**A1**	Must be identified. If M0 scored then **SC B1** for 4320 as the only answer.
	$[4860 - 4320 =] 540$	**A1**	
		3	

Question 59

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

Question 60

Coefficient of $x^4 = 15$	**B1**	Condone inclusion of x^4. Can be seen as part of an expansion.
Coefficient of $x^2 = 240a^2$	**B1**	Condone inclusion of x^2. Can be seen as part of an expansion.
'Their 240'a^2 – 'their 15'	**M1**	Forming an equation of the form $pa^2 = q$, where p and q are constants. Condone inclusion of powers of x as long as they then disappear.
$a = \dfrac{1}{4}$ or 0.25	**A1**	OE Do not condone extra 'answer' of $-\dfrac{1}{4}$, or allow $\sqrt{\dfrac{1}{16}}$ or similar.
	4	

Question 61

(a)	x^4 term is $\left[10\times\right]\left(2x^2\right)^3\left(\dfrac{k^2}{x}\right)^2$	M1	For selecting the term in x^4.
	$80k^4x^4 \Rightarrow a = 80k^4$	A1	For correct value of a. Allow $80k^4x^4$.
	$\left[x^2 \text{ term is } \left[6\times\right](2kx)^2 \times 1 = 24k^2x^2 \Rightarrow\right]\ b = 24k^2$	B1	For correct value of b. Allow $24k^2x^2$.
		3	
(b)	$80k^4 + 24k^2 - 216[=0]\qquad\left[\Rightarrow 10k^4 + 3k^2 - 27 = 0\right]$	M1	Forming a 3-term equation in k (all terms on one side) with *their* a and b and no x's.
	$\left(2k^2 - 3\right)\left(5k^2 + 9\right)\ [=0]\ [\Rightarrow k^2 = \dfrac{3}{2}\ \text{or}\ -\dfrac{9}{5}]$	M1	Attempt to solve 3-term quartic (or quadratic in another variable) by factorisation, formula or completing the square – see guidance.
	$[k] = \pm\sqrt{\dfrac{3}{2}}$	A1	OE e.g. $\pm\dfrac{\sqrt{6}}{2}$, $\pm\sqrt{1.5}$, 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	

Question 62

(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	

Question 63

Coefficient of x^2 in $\left(1+\dfrac{2}{p}x\right)^5$ is $10\left(\dfrac{2}{p}\right)^2 = \dfrac{10\times2^2}{p^2}\left[=\dfrac{40}{p^2}\right]$		**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 $^6C_2$
$\dfrac{40}{p^2}+15p^2=70$		***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.
$[5]\left(p^2-4\right)\left(3p^2-2\right)[=0]$ or $\dfrac{70\pm\sqrt{70^2-4(15)(40)}}{30}$ or $\dfrac{14\pm\sqrt{14^2-4(3)(8)}}{6}$		**DM1**	Attempt to solve 3-term quartic (or quadratic in another variable) by factorisation, formula or completing the square.
$p=\pm2,\ \pm\sqrt{\dfrac{2}{3}}$		**A1**	OE e.g. $\pm\dfrac{\sqrt{6}}{3}$ or AWRT ±0.816 If *M1 DM1 DM0, allow **SC B1** for 4 correct values.
		6	

Question 64

$7C1\left(\dfrac{x}{a}\right)^6\left(\dfrac{a}{x^2}\right)$ or $7C6\left(\dfrac{x}{a}\right)^6\left(\dfrac{a}{x^2}\right)$ $7C2\left(\dfrac{x}{a}\right)^5\left(\dfrac{a}{x^2}\right)^2$ or $7C5\left(\dfrac{x}{a}\right)^5\left(\dfrac{a}{x^2}\right)^2$		**B1 B1**	Coefficients x^4 & x. Can be seen in an expansion.
$\dfrac{\left(\dfrac{7}{a^5}\right)}{\left(\dfrac{21}{a^3}\right)}=3$		**M1**	OE. Allow extraneous x^4 and x at this stage; numerator and denominator must be functions of a. Allow errors in evaluation of the combinations.
		A1	Completely correct.
$a^2=\dfrac{1}{9}$		**A1**	SOI (implied by $a=\dfrac{1}{3}$).
$a=\pm\dfrac{1}{3}$		**A1**	Allow $\pm\,0.333$.
		6	

Question 65

(a)	$x^5+10x^3+40x+\dfrac{80}{x}+\dfrac{80}{x^3}+\dfrac{32}{x^5}$ 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* $40\times a+\left(\text{*their* coefficient of }x^{-1}\right)\times b=0$	**M1**	Coefficients of a and b must be non-zero, allow x's so long as they are dealt with correctly.
	$\left(\text{*their* coefficient of }x^{-1}\right)\times a+\left(\text{*their* coefficient of }x^{-3}\right)\times b=80$	**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	

Question 66

[Coefficient of $x^4 = p =$] $15a^2$	**B1**	May be seen in an expansion or with x^4.
[Coefficient of $x^2 = q =$] $54a^2$	**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	

Question 67

:(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)	$(16 \times 40) - (10 \times 96) + (1 \times 216)$	**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	

Question 68

(a)(i)	$1 + 10x + 40x^2$	**B1**	Ignore any additional terms (ISW). Allow x^0 or $1\,x^0$ for the first term, allow lists.
		1	
(a)(ii)	$\{1\}\{-6ax\}\{+15a^2x^2\}$	**B2, 1, 0**	Ignore any additional terms (ISW). Allow x^0 or $1\,x^0$ for the first term, allow lists.
		2	
(b)	$15a^2 - 60a + 40 = -5$	**M1 A1**	Correct 3 products from *their* expansions for M1. Condone inclusion of x^2 for M1.
	$[15](a-1)(a-3)[=0]$ OE	**DM1**	OE. Rearranging and solving a quadratic.
	$a = 1$ and 3	**A1**	**Special case:** If M1 A1 DM0 scored then **SC B1** can be awarded for correct answers.
		4	

Question 69

[Coefficient of x^3 from $(3 + 2ax)^5 =$] $10 \times 9 \times 8a^3$ $\left[= 720a^3\right]$		**B1**	May be seen in an expansion or with x^3.
[Coefficient of x^2 from $(2 + ax)^6 =$] $15 \times 16 \times a^2$ $\left[= 240a^2\right]$		**B1**	May be seen in an expansion or with x^2.
their $(10 \times 9 \times 8a^3) = 6 \times their (15 \times 16 \times a^2)$ $\left[\Rightarrow 720a^3 = 1440a^2\right]$		**M1**	OE Equating *their* <u>coefficient</u> of x^3 and $6 \times$ *their* <u>coefficient</u> of x^2.
$a = 2$		**A1**	Condone extra solution $a = 0$.
		4	

Question 70

(a)	$1+18x+135x^2$	**B2, 1, 0**	Accept 1, $18x$, $135x^2$ listed horizontally or vertically or $1x^0+18x+135x^2$.
		2	
(b)	Coefficient of x^2 is $135-7\times18+1=10$	**M1 A1**	3 products, allow $10x^2$. If full expansion given, like terms must be collected for M1.
		2	

Question 71

$\binom{4}{2}2^2(ax)^2$, $\binom{4}{3}2^{[1]}(ax)^3$	**B1 B1**	OE Expect $24a^2x^2, 8a^3x^3$ (may be seen in an expansion).
Multiply terms involving x^2 and x^3 by $5-ax$ to obtain x^3 term	***M1**	Must find two products only (may be seen in an expansion).
Equate coefficient of x^3 to 432 and solve for a	**DM1**	Ignore inclusion of x^3 at this stage.
Obtain $a=3$ only	**A1**	
	5	

Question 72

Correct second term $30x$ in expansion of $(1+3x)^{10}$	**B1**	WWW, may be implied later.
Correct third term $+405x^2$	**B1**	Ignore subsequent terms, may be implied later.
Multiply $(2-5x)$ by *their* $30x+405x^2$ to obtain two x^2 terms only	**M1**	Expect $-150x^2, 810x^2$.
Coefficient is 660	**A1**	Must be clearly identified. Allow final answer $660x^2$.
	4	

Question 73

$240\left[x^2\right]$ or $80a^2\left[x^2\right]$	**B1**	May be seen in an expansion.
$240=12\times80a^2$	**M1**	*Their* 240 equated to $12\times$ *their* $80a^2$ which must contain a^2.
0.5	**A1**	OE Condone ±0.5
	3	

Question 74

(a)	$20\times27\times a^3[=160]$	**M1**	Allow 6C3 $\times$ $3^3\times a^3[=160]$. Accept $540a^3$ with no other working for M1.
	$[a]=\dfrac{2}{3}$	**A1**	Allow 0.667 AWRT. **SC B1** is $a=\dfrac{2}{3}$ with no other working.
		2	
(b)	Coefficient of x^2 is $15\times81\times\left(their\dfrac{2}{3}\right)^2[=540]$	**B1 FT**	May be in a list. 6C2 and 3^4 must be evaluated but may be implied by later work. Condone 540 with no working.
	$160\times1-2\times their\,540$	**M1**	
	$=-920$	**A1**	Condone $-920x^3$.
		3	

Question 75

(a)	$x^3 : \binom{5}{3} 3^2 (-ax)^3 \left[-10 \times 3^2 \times a^3\right]$ or $x^4 : \binom{5}{4} 3(-ax)^4 \left[5 \times 3 \times a^4\right]$	M1	Allow for either term, allow sign error and combination notation.
	$x^3 : -90a^3$	A1	Allow in the full expansion.
	$x^4 : 15a^4$	A1	Allow in the full expansion.
		3	
(b)	Coefficient of x^4 is $a \times their -90a^3 + 7 \times their\ 15a^4$ $\left[=15a^4\right]$	M1	Must select two appropriate terms only.
	$15a^4 = 240$	DM1	Reducing to a simple quartic equation in a.
	$\Rightarrow a^4 = 16 \Rightarrow a = 2$	A1	A0 if $a = -2$ is given as a solution.
		3	

Question 76

(a)	15 or $\binom{6}{2} \times x^4 \left(\dfrac{3}{x^2}\right)^2$ or $x^6 \times \dfrac{6 \times 5}{2} \left(\dfrac{3}{x^3}\right)^2$	B1	OE May be in a list. Allow $\binom{6}{4}$.
	135	B1	Correct term must be identified if in a list. Allow $135x^0$.
		2	
(b)	20 or $\binom{6}{3} \times x^3 \left(\dfrac{3}{x^2}\right)^3$ or $x^6 \times \dfrac{6.5.4}{3!} \left(\dfrac{3}{x^3}\right)^3$	B1	OE May be in a list.
	$= \dfrac{540}{x^3}$	B1	Identifying $\dfrac{1}{x^3}$ term. This can be implied by sight of 2160 as part of the constant term.
	$4 \times 540 - 5 \times 135$	M1	$4 \times their\ 540 - 5 \times their\ 135$
	1485	A1	Allow $1485x^0$.
		4	

Question 77

Identify correct term and obtain $6(kx)^2 \cdot \left(\dfrac{2}{x}\right)^2$	M1	Needs numerical coefficient or $\dfrac{4!}{2!2!}$, not $^4C_2$.
Equate to 150 and obtain $k = \dfrac{5}{2}$	A1	Ignore $-\dfrac{5}{2}$
Identify correct term $4(kx)^3 \cdot \left(\dfrac{2}{x}\right)$ with their value of k	M1	Needs numerical coefficient or $\dfrac{4!}{3!1!}$.
Obtain coefficient 125	A1	Accept $125x^2$ as final answer.
	4	

Question 78

(a)			
	$(2x)^4$ and $\left(\dfrac{\pm 3}{x}\right)^4$	**B1**	May be seen in a full expansion. This can be implied by $16x^4$ and $+\dfrac{81}{x^4}$ unless they are clearly using $+\dfrac{3}{x}$ throughout.
	$4(2x)^3\left(\dfrac{-3}{x}\right)+6(2x)^2\left(\dfrac{-3}{x}\right)^2+4(2x)\left(\dfrac{-3}{x}\right)^3$	**B1**	Correct combination of numerical coefficients for the middle three terms. Can be implied by a correct full expansion.
	$\left[16x^4\right]+k_1x^2+k_2\left[x^0\right]+k_3x^{-2}\left[+81x^{-4}\right]$	**M1**	OE Powers now simplified correctly with *their* k_1, k_2, $k_3 \neq 0$.
	$16x^4 - 96x^2 + 216 - 216x^{-2} + 81x^{-4}$	**A1**	OE
		4	
(b)	Use of (*their* 216) $+ 5\times$(*their* -96) only, to arrive at the coefficient of x^2	**M1**	Other terms may be seen.
	-264	**A1**	Accept $-264x^2$ as the final answer.
		2	

Question 79

(a)			
	$\{32\left[x^0\right]\}\{-120x\}\{+180x^2\}$	**B1B1B1**	Coefficients must be simplified. Ignore further terms in the expansion. **SC B3:** $2^5\left(1-\dfrac{15}{4}x+\dfrac{45}{8}x^2\ldots\right)$ can be awarded full marks, ISW.
		3	
(b)	$x = 0.01$ or $\dfrac{1}{100}$	**B1**	Identify 0.01 as the only value to substitute, condone any method.
	(*Their* $32 - 120x + 180x^2$) with $x = $ (*their* 0.01)	**M1**	Clear use of *their* x-value from *their* solution of $2 - \dfrac{3}{2}x = 1.985$ and *their* answer to **(a)**. Expect $32 - 120(0.01) + 180(0.01)^2 = 32 - 1.2 + 0.018$. Condone substitution into further terms in the expansion.
	$30.8[18]$	**A1**	Correct answer to at least 3sf coming from substitution into three or more terms. 'Correct' answers without appropriate working get A0.
		3	

Question 80

$\dbinom{5}{3}$ or $\dbinom{5}{2}$ or $10\times\left(px^2\right)^{5-3}\times\left(\dfrac{4}{p}x\right)^3$	**B1**	May be seen in a list. Allow with or without x's. Condone missing brackets only if recovered later.
$10p^2\times\dfrac{64}{p^3}$	**B1**	This term must now be identified if given as part of a list. Allow with or without x's.
$\dfrac{\textit{Their}\text{ integer }k}{p}\left[x^7\right] = 1280\left[x^7\right]$	**M1**	Condone e.g. $\dfrac{640x^7}{p} = 1280$ if x^7 then disappears in subsequent work. Must be from $a\times\left(px^2\right)^{5-3}\times\left(\dfrac{4}{p}x\right)^3$.
$p = \dfrac{1}{2}$	**A1**	OE **SC B1** for $\dbinom{5}{4}$ or $\dbinom{5}{1}$ or $5\times\left(px^2\right)^{5-1}\times\left(\dfrac{4}{px}\right)^1 \Rightarrow p = 4$.
	4	

Question 81

(a)(i)	$32 - 80px + 80p^2x^2$	**B2,1,0**	B2 for all correct. B1 for any two correct. May be in a list. Ignore terms with higher powers.
		2	
(a)(ii)	$1 - 2x + \dfrac{3}{2}x^2$	**B2,1,0**	OE B2 for all correct. B1 for any two correct. May be in a list. Ignore terms with higher powers.
		2	
(b)	Coefficient of $x^2 = 32 \times \dfrac{3}{2} + (-2 \times -80p) + 80p^2$	***M1**	3 terms FT *their* values.
	$48 + 160p + 80p^2 = 93 \implies 5(4p + 9)(4p - 1)[= 0]$	**DM1**	Set *their* 3-term coefficient to 93 and attempt to solve by factorising or other accepted method for solving their 3-term quadratic.
	$p = -\dfrac{9}{4}$ and $p = \dfrac{1}{4}$	**A1**	**SC B1** following M0 if method for solving quadratic is not shown.
		3	