Binomial Expansion- Mark Scheme

June 2019 Mathematics Advanced Paper 1: Pure Mathematics 1

1.

Question	Scheme	Marks	AOs
4 (a)	$\frac{1}{\sqrt{4-x}} = (4-x)^{-\frac{1}{2}} = 4^{-\frac{1}{2}} \times (1 \pm ......$	M1	2.1
	Uses a "correct" binomial expansion for their $(1+ax)^n = 1 + nax + \frac{n(n-1)}{2}a^2x^2 +$	M1	1.1b
	$\left(1-\frac{x}{4}\right)^{-\frac{1}{2}} = 1 + \left(-\frac{1}{2}\right)\left(-\frac{x}{4}\right) + \frac{\left(-\frac{1}{2}\right)\times\left(-\frac{3}{2}\right)}{2}\left(-\frac{x}{4}\right)^2$	A1	1.1b
	$\frac{1}{\sqrt{4-x}} = \frac{1}{2} + \frac{1}{16}x + \frac{3}{256}x^2$	A1	1.1b
		(4)	
(b) (i)	States $x = -14$ and gives a valid reason. Eg explains that the expansion is not valid for $\lvert x \rvert > 4$	B1	2.4
		(1)	
(b)(ii)	States $x = -\frac{1}{2}$ and gives a valid reason. Eg. explains that it is closest to zero	B1	2.4
		(1)	
		(6 marks)	

(a)

M1: For the strategy of expanding $\frac{1}{\sqrt{4-x}}$ using the binomial expansion.

You must see $4^{-\frac{1}{2}}$ oe and an expansion which may or may not be combined.

M1: Uses a correct binomial expansion for their $(1 \pm ax)^n = 1 \pm nax \pm \frac{n(n-1)}{2}a^2x^2 +$

Condone sign slips and the "a" not being squared in term 3. Condone $a = \pm 1$
Look for an attempt at the correct binomial coefficient for their n, being combined with the correct power of ax

A1: $\left(1-\frac{x}{4}\right)^{-\frac{1}{2}} = 1 + \left(-\frac{1}{2}\right)\left(-\frac{x}{4}\right) + \frac{\left(-\frac{1}{2}\right)\times\left(-\frac{3}{2}\right)}{2}\left(-\frac{x}{4}\right)^2$ unsimplified

FYI the simplified form is $1 + \frac{x}{8} + \frac{3x^2}{128}$ Accept the terms with commas between.

A1: $\frac{1}{\sqrt{4-x}} = \frac{1}{2} + \frac{1}{16}x + \frac{3}{256}x^2$ Ignore subsequent terms. Allow with commas between.

Note: Alternatively $(4-x)^{-\frac{1}{2}} = 4^{-\frac{1}{2}} + \left(-\frac{1}{2}\right)4^{-\frac{3}{2}}(-x) + \frac{\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)}{2}4^{-\frac{5}{2}}(-x)^2 + ..$

M1: For $4^{-\frac{1}{2}} + ...$ **M1:** As above but allow slips on the sign of x and the value of n **A1:** Correct unsimplified (as above) **A1:** As main scheme

(b) Any evaluations of the expansions are irrelevant.

Look for a suitable value and a suitable reason for both parts.

(b)(i)

B1: Requires $x = -14$ with a suitable reason.

Eg. $x = -14$ as the expansion is only valid for $|x| < 4$ or equivalent.

Eg ' $x = -14$ as $|-14| > 4$" or ' I cannot use $x = -14$ as $\left|\frac{-14}{4}\right| > 1$ '

Eg. ' $x = -14$ as is outside the range $|x| < 4$ '

Do not allow ' -14 is too big' or ' $x = -14, |x| < 4$ ' either way around without some reference to the validity of the expansion.

(b)(ii)

B1: Requires $x = -\frac{1}{2}$ with a suitable reason.

Eg. $x = -\frac{1}{2}$ as it is 'the smallest/smaller value' or ' $x = -\frac{1}{2}$ as the value closest to zero' (that will give the more accurate approximation). The bracketed statement is not required.

June 2018 Mathematics Advanced Paper 1: Pure Mathematics 1

2.

Question	Scheme	Marks	AOs
11 (a)	$\sqrt{\frac{1+4x}{1-x}}=(1+4x)^{0.5}\times(1-x)^{-0.5}$	B1	3.1a
	$(1+4x)^{0.5}=1+0.5\times(4x)+\frac{0.5\times-0.5}{2}\times(4x)^2$ $(1-x)^{-0.5}=1+(-0.5)(-x)+\frac{(-0.5)\times(-1.5)}{2}(-x)^2$ $(1+4x)^{0.5}=1+2x-2x^2$ and $(1-x)^{-0.5}=1+0.5x+0.375x^2$ oe	M1 M1 A1	1.1b 1.1b 1.1b
	$(1+4x)^{0.5}\times(1-x)^{-0.5}=(1+2x-2x^2......)\times\left(1+\frac{1}{2}x+\frac{3}{8}x^2...\right)$ $=1+\frac{1}{2}x+\frac{3}{8}x^2+2x+x^2-2x^2+...$ $=A+Bx+Cx^2$	dM1	2.1
	$=1+\frac{5}{2}x-\frac{5}{8}x^2......$ *	A1*	1.1b
		(6)	
(b)	Expression is valid $\|x\|<\frac{1}{4}$ Should not use $x=\frac{1}{2}$ as $\frac{1}{2}>\frac{1}{4}$	B1	2.3
		(1)	
(c)	Substitutes $x=\frac{1}{11}$ into $\sqrt{\frac{1+4x}{1-x}}\approx1+\frac{5}{2}x-\frac{5}{8}x^2$	M1	1.1b
	$\sqrt{\frac{3}{2}}=\frac{1183}{968}$	A1	1.1b
	(so $\sqrt{6}$ is) $\frac{1183}{484}$ or $\frac{2904}{1183}$	A1	2.1
		(3)	
			(10 marks)

(a)

B1: Scored for key step in setting up the process so that it can be attempted using binomial expansions

This could be achieved by $\sqrt{\frac{1+4x}{1-x}}=(1+4x)^{0.5}\times(1-x)^{-0.5}$ See end for other alternatives

It may be implied by later work.

M1: Award for an attempt at the binomial expansion $(1+4x)^{0.5}=1+0.5\times(4x)+\frac{(0.5)\times(-0.5)}{2}\times(4x)^2$

There must be three (or more terms). Allow a missing bracket on the $(4x)^2$ and a sign slip so the correct application may be implied by $1+2x\pm0.5x^2$

M1: Award for an attempt at the binomial expansion $(1-x)^{-0.5}=1+(-0.5)(-x)+\frac{(-0.5)\times(-1.5)}{2}(-x)^2$

There must be three (or more terms). Allow a missing bracket on the $(-x)^2$ and a sign slips so the method may be awarded on $1\pm0.5x\pm0.375x^2$

A1: Both correct and simplified. This may be awarded for a correct final answer if a candidate does all their simplification at the end

dM1: In the main scheme it is for multiplying their two expansions to reach a quadratic. It is for the key step in adding 'six' terms to produce the quadratic expression. Higher power terms may be seen. Condone slips on

A1: Finds both sides leading to a correct equation/statement $\sqrt{\frac{15}{10}}=\frac{1183}{968}$ oe $\sqrt{6}=2\times\frac{1183}{968}$

A1: $\sqrt{6}=\frac{1183}{484}$ or $\sqrt{6}=\frac{2904}{1183}$ $\qquad\sqrt{6}=2\times\frac{1183}{968}=\frac{1183}{484}$ would imply all 3 marks

....

Watch for other equally valid alternatives for 11(a) including

B1: $(1+4x)^{0.5}\approx\left(1+\frac{5}{2}x-\frac{5}{8}x^2\right)(1-x)^{0.5}$ then the M's are for $(1+4x)^{0.5}$ and $(1-x)^{0.5}$

M1: $(1-x)^{0.5}=1+(0.5)(-x)+\frac{(0.5)\times(-0.5)}{2}(-x)^2$

....

the multiplication on one term only. It is dependent upon having scored the first B and one of the other two M's

In the alternative it is for multiplying $\left(1+\frac{5}{2}x-\frac{5}{8}x^2\right)(1-x)^{0.5}$ and comparing it to $(1+4x)^{0.5}$

It is for the key step in adding 'six' terms to produce the quadratic expression.

A1*: Completes proof with no errors or omissions. In the alternative there must be some reference to the fact that both sides are equal.

(b)

B1: States that the expansion may not / is not valid when $|x|>\frac{1}{4}$

This may be implied by a statement such as $\frac{1}{2}>\frac{1}{4}$ or stating that the expansion is only valid when $|x|<\frac{1}{4}$

Condone, for this mark a candidate who substitutes $x=\frac{1}{2}$ into the $4x$ **and** states it is not valid as $2>1$ oe

Don't award for candidates who state that $\frac{1}{2}$ is too big without any reference to the validity of the expansion.

As a rule you should see some reference to $\frac{1}{4}$ or $4x$

(c)(i)

M1: Substitutes $x=\frac{1}{11}$ into BOTH sides $\sqrt{\frac{1+4x}{1-x}}\approx1+\frac{5}{2}x-\frac{5}{8}x^2$ and attempts to find at least one side.

As the left hand side is $\frac{\sqrt{6}}{2}$ they may multiply by 2 first which is acceptable

Or

B1: $\sqrt{\frac{1+4x}{1-x}}=\sqrt{1+\frac{5x}{1-x}}=\left(1+5x(1-x)^{-1}\right)^{\frac{1}{2}}$ then the first M1 for one application of binomial and the second would be for both $(1-x)^{-1}$ and $(1-x)^{-2}$

....

Or

B1: $\sqrt{\frac{1+4x}{1-x}}\times\frac{\sqrt{1-x}}{\sqrt{1-x}}=\sqrt{(1+3x-4x^2)}\times(1-x)^{-1}=\left(1+\left(3x-4x^2\right)\right)^{\frac{1}{2}}\times(1-x)^{-1}$

May 2019 Mathematics Advanced Paper 1: Pure Mathematics 1

3.

Question	Scheme	Marks	AOs
8(a)	2^6 or 64 as the constant term	B1	1.1b
	$\left(2+\frac{3x}{4}\right)^6=...+{}^6\mathrm{C}_1 2^5\left(\frac{3x}{4}\right)^1+{}^6\mathrm{C}_2 2^4\left(\frac{3x}{4}\right)^2+...$ $=...+6\times2^5\left(\frac{3x}{4}\right)^1+\frac{6\times5}{2}\times2^4\left(\frac{3x}{4}\right)^2+...$	M1 A1	1.1b 1.1b
	$=64+144x+135x^2+...$	A1	1.1b
		(4)	
(b)	$\frac{3x}{4}=-0.075\Rightarrow x=-0.1$ So find the value of $64+144x+135x^2$ with $x=-0.1$	B1ft	2.4
		(1)	
			(5 marks)

(a)

B1: Sight of either 2^6 or 64 as the constant term

M1: An attempt at the binomial expansion. This may be awarded for a correct attempt at either the second **OR** third term. Score for the correct binomial coefficient with the correct power of 2 and the correct power of $\frac{3x}{4}$ condoning slips. Correct bracketing is not essential for this M mark.

Condone ${}^6C_2 2^4 \frac{3x}{4}^2$ for this mark

A1: Correct (unsimplified) second **AND** third terms.

The binomial coefficients must be processed to numbers /numerical expression e.g $\frac{6!}{4!2!}$ or $\frac{6\times5}{2}$

They cannot be left in the form ${}^6C_1$ and/or $\binom{6}{2}$

A1: $64+144x+135x^2+...$ Ignore any terms after this. Allow to be written $64, 144x, 135x^2$

(b)

B1ft: $x=-0.1$ or $-\frac{1}{10}$ **with** a comment about substituting this into their $64+144x+135x^2$

If they have written (a) as $64, 144x, 135x^2$ candidate would need to say substitute $x=-0.1$ into the sum of the first three terms.

As they do not have to perform the calculation allow

Set $2+\frac{3x}{4}=1.925$, solve for x and then substitute this value into the expression from (a)

If a value of x is found then it must be correct

Alternative to part (a)

$$\left(2+\frac{3x}{4}\right)^6=2^6\left(1+\frac{3x}{8}\right)^6=2^6\left(1+{}^6C_1\left(\frac{3x}{8}\right)^1+{}^6C_2\left(\frac{3x}{8}\right)^2+...\right)$$

B1: Sight of either 2^6 or 64

M1: An attempt at the binomial expansion. This may be awarded for either the second or third term. Score for the correct binomial coefficient with the correct power of $\frac{3x}{8}$ Correct bracketing is not essential for this mark.

A1: A correct attempt at the binomial expansion on the second and third terms.

A1: $64+144x+135x^2+...$ Ignore any terms after this.

May 2018 Mathematics Advanced Paper 1: Pure Mathematics 1

4.

Question	Scheme	Marks	AOs
11(a)	$\left(2-\frac{x}{16}\right)^9 = 2^9 + \binom{9}{1}2^8.\left(-\frac{x}{16}\right)+\binom{9}{2}2^7.\left(-\frac{x}{16}\right)^2 + ...$	M1	1.1b
	$\left(2-\frac{x}{16}\right)^9 = 512 + ...$	B1	1.1b
	$\left(2-\frac{x}{16}\right)^9 = ... -144x + ...$	A1	1.1b
	$\left(2-\frac{x}{16}\right)^9 = ... + ... + 18x^2 \ (+ ...)$	A1	1.1b
		(4)	
(b)	Sets $'512'a = 128 \Rightarrow a = ...$	M1	1.1b
	$(a=)\frac{1}{4}$ oe	A1 ft	1.1b
		(2)	
(c)	Sets $'512'b + '-144'a = 36 \Rightarrow b = ...$	M1	2.2a
	$(b=)\frac{9}{64}$ oe	A1	1.1b
		(2)	
			(8 marks)
11(a) alt	$\left(2-\frac{x}{16}\right)^9 = 2^9\left(1-\frac{x}{32}\right)^9 = 2^9\left(1+\binom{9}{1}\left(-\frac{x}{32}\right)+\binom{9}{2}\left(-\frac{x}{32}\right)^2 + ...\right)$	M1	1.1b
	$= 512 + ...$	B1	1.1b
	$= ... -144x + ...$	A1	1.1b
	$= ... + ... + 18x^2 \ (+ ...)$	A1	1.1b

Notes Mark (a)(b) and (c) as one complete question

(a)

M1: Attempts the binomial expansion. May be awarded on either term two and/or term three Scored for a correct binomial coefficient combined with a correct power of 2 and a correct power of $\left(\pm\frac{x}{16}\right)$ Condone $\binom{9}{2}2^7.\left(-\frac{x^2}{16}\right)$ for term three.

Allow any form of the binomial coefficient. Eg $\binom{9}{2} = {}^9C_2 = \frac{9!}{7!2!} = 36$

In the alternative it is for attempting to take out a factor of 2 (may allow 2^n outside bracket) and having a correct binomial coefficient combined with a correct power of $\left(\pm\frac{x}{32}\right)$

B1: For 512

A1: For $-144x$

A1: For $+\ 18x^2$ Allow even following $\left(+\frac{x}{16}\right)^2$

Listing is acceptable for all 4 marks

(b)

M1: For setting their $512a=128$ and proceeding to find a value for *a*. Alternatively they could substitute $x=0$ into both sides of the identity and proceed to find a value for *a*.

A1 ft: $a=\frac{1}{4}$ oe Follow through on $\frac{128}{\text{their } 512}$

(c)

M1: Condone $512b \pm 144 \times a = 36$ following through on their 512, their -144 and using their value of "*a*" to find a value for "*b*"

A1: $b=\frac{9}{64}$ oe

May 2017 Mathematics Advanced Paper 1: Pure Mathematics 2

5.

Question Number	Scheme	Marks
1.	$\left(3-\frac{1}{3}x\right)^5$ - $3^5 + {}^5C_1 3^4(-\frac{1}{3}x) + {}^5C_2 3^3(-\frac{1}{3}x)^2 + {}^5C_3 3^2(-\frac{1}{3}x)^3 ...$ First term of 243 $\left({}^5C_1 \times ... \times x\right) + \left({}^5C_2 \times ... \times x^2\right) + \left({}^5C_3 \times ... \times x^3\right) ...$ $=(243 ..) - \frac{405}{3}x + \frac{270}{9}x^2 - \frac{90}{27}x^3 ...$ $=(243 ..) - 135x + 30x^2 - \frac{10}{3}x^3 ..$	 B1 M1 A1 A1 (4) **[4]**
Alternative method	$\left(3-\frac{1}{3}x\right)^5 = 3^5(1-\frac{x}{9})^5$ $3^5(1 + {}^5C_1(-\frac{1}{9}x) + {}^5C_2(-\frac{1}{9}x)^2 + {}^5C_3(-\frac{1}{9}x)^3 \ ...)$ Scheme is applied exactly as before	

	Notes
	B1: The constant term should be 243 in their expansion M1: Two of the three binomial coefficients must be correct and must be with the correct power of x. Accept ${}^5C_1$ or $\binom{5}{1}$ or 5 **as a coefficient, and** ${}^5C_2$ or $\binom{5}{2}$ or 10 **as another and** ${}^5C_3$ or $\binom{5}{3}$ or 10 **as another……..** Pascal's triangle may be used to establish coefficients. NB: If they only include the first two of these terms then the M1 may be awarded. A1: Two of the final three terms correct – may be unsimplified i.e. two of $-135x + 30x^2 - \frac{10}{3}x^3$ correct, or two of $-\frac{405}{3}x + \frac{270}{9}x^2 - \frac{90}{27}x^3$ (may be just two terms) A1: All three final terms correct and simplified. (Can be listed with commas or appear on separate lines. Accept in reverse order.) Accept correct alternatives to $-\frac{10}{3}$ e.g. $-3\frac{1}{3}$ or $-3.\dot{3}$ the recurring must be clear. 3.3 is not acceptable. Allow e.g. $+-135x$
	e.g. The common error $3^5 + {}^5C_1 3^4(-\frac{1}{3})x + {}^5C_2 3^3(-\frac{1}{3})x^2 + {}^5C_3 3^2(-\frac{1}{3})x^3 = (243) - 135x - 90x^2 - 30x^3$ would earn B1, M1, A0, A0, so 2/4 If extra terms are given then isw No negative signs in answer also earns B1, M1, A0, A0 If the series is divided through by 3 at the final stage after an error or omission resulting in all multiple of three coefficients then apply scheme to series before this division and ignore subsequent work (isw) **Special Case**: Only gives first three terms $= (243..) - 135x + 30x^2 ...$ or $243 - \frac{405}{3}x + \frac{270}{9}x^2$ Follow the scheme to give B1 M1 A1 A0 special case. (Do not treat as misread.) Answers such as $243 + 405 - \frac{1}{3}x + 270 - \frac{1}{9}x^2 + 90 - \frac{1}{27}x^3$.. gain no credit as the binomial coefficients are not linked to the x terms.

May 2015 Mathematics Advanced Paper 1: Pure Mathematics 2

6.

Question Number	Scheme		Marks
1.	$\left(2 - \frac{x}{4}\right)^{10}$		
Way 1	$2^{10} + \binom{10}{1}2^9\left(-\frac{1}{4}x\right) + \binom{10}{2}2^8\left(-\frac{1}{4}x\right)^2 + ...$	For **either** the x term **or** the x^2 term including a correct binomial coefficient with a correct power of x	M1
		First term of 1024	B1
	$= 1024 - 1280x + 720x^2$	**Either** $-1280x$ **or** $720x^2$ (Allow +-1280x here)	A1
		Both $-1280x$ and $720x^2$ (Do not allow +-1280x here)	A1 **[4]**
Way 2	$\left(2 - \frac{x}{4}\right)^{10} = 2^k\left(1 - 10 \times \frac{x}{8} + \frac{10 \times 9}{2}\left(-\frac{x}{8}\right)^2\right)$		M1
	$1024(1 \pm ....)$ $= 1024 - 1280x + 720x^2$		B1A1 A1 **[4]**

Notes

M1: For <u>either</u> the x term <u>or</u> the x^2 term having correct structure i.e. a <u>correct</u> binomial coefficient in any form with the <u>correct power of x</u>. Condone sign errors and condone missing brackets and allow alternative forms for binomial coefficients e.g. ${}^{10}C_1$ or $\binom{10}{1}$ or even $\left(\frac{10}{1}\right)$ or 10. The powers of 2 or of ¼ may be wrong or missing.

B1: Award this for 1024 when first seen as a distinct constant term (not $1024x^0$) and not 1 + 1024

A1: For one correct term in x with coefficient simplified. Either $-1280x$ or $720x^2$ (allow $+-1280x$ here)

Allow $720x^2$ to come from $\left(\frac{x}{4}\right)^2$ with no negative sign. So use of + sign throughout could give M1 B1 A1 A0

A1: For both correct simplified terms i.e. $-1280x$ and $720x^2$ (**Do not** allow $+-1280x$ here)

Allow terms to be listed for full marks e.g. <u>1024,</u> $-1280x$, $+ 720x^2$

N.B. If they follow a correct answer by a factor such as $512-640x+360x^2$ then isw

Terms may be listed. Ignore any extra terms.

Notes for Way 2

M1: Correct structure for at least one of the underlined terms. i.e. a <u>correct</u> binomial coefficient in any form with the <u>correct power of x</u>. Condone sign errors and condone missing brackets and allow alternative forms for binomial coefficients e.g. ${}^{10}C_1$ or $\binom{10}{1}$ or even $\left(\frac{10}{1}\right)$ or 10. k may even be 0 or 2^k may not be seen. Just consider the bracket for this mark.

B1: Needs 1024(1…. To become 1024

A1, A1: as before

Jan 2013 Mathematics Advanced Paper 1: Pure Mathematics 2

7.

Question Number	Scheme		Marks
1.	$(2-5x)^6$		
	$(2^6 =)\ 64$	Award this when first seen (not $64x^0$)	B1
	$+6\times(2)^5(-5x)+\frac{6\times5}{2}(2)^4(-5x)^2$	Attempt binomial expansion with correct structure for at least one of these terms. E.g. a term of the form: $\binom{6}{p}\times(2)^{6-p}(-5x)^p$ with $p=1$ or $p=2$ consistently. Condone sign errors. Condone missing brackets if later work implies correct structure and allow alternative forms for binomial coefficients e.g. ${}^6C_1$ or $\binom{6}{1}$ or even $\left(\frac{6}{1}\right)$	M1

	$-960x$	Do **not** allow $+-960x$	A1 (first)
	$(+)6000x^2$	Allow this to come from $(5x)^2$	A1 (Second)
	Ignore any extra terms and isw e.g. divides all terms by 2 The terms do not have to form a sum i.e. they can be listed with commas or given on separate lines.		
	Special Case - decreasing powers can score M1 with the conditions as above for the second and third terms.		
	$(2-5x)^6 = 64+\binom{6}{1}(2^5-5x)+\binom{6}{2}(2^4+(-5x)^2)$ **scores B1 only as the powers of 2 and (-5x) are being added not multiplied.**		
	Fully correct answer with no working can score full marks. If either the second or third term is correct, the M1 can be implied and the A1 scored for that term.		
			(4)
Way 2	$64(1\pm............)$	64 **and** (1 ± ..... – Award when first seen.	B1
	$\left(1-\frac{5x}{2}\right)^6 = 1\ \underline{-6\times\frac{5x}{2}}+\underline{\frac{6\times5}{2}\left(-\frac{5x}{2}\right)^2}$	Correct structure for at least one of the underlined terms. E.g. a term of the form: $\binom{6}{p}\times(kx)^p$ with $p=1$ or $p=2$ consistently and $k\neq\pm5$ Condone sign errors. Condoned missing brackets if later work implies correct structure but it must be an expansion of $(1-kx)^6$ where $k\neq\pm5$	M1
	$-960x$	Do **not** allow $+-960x$	A1
	$(+)6000x^2$	Allow this to come from $\left(\frac{5x}{2}\right)^2$	A1
			(4)

May 2012 Mathematics Advanced Paper 1: Pure Mathematics 2

8.

Question number	Scheme	Marks
1	$\left[(2-3x)^5\right] = \ldots \quad +\binom{5}{1}2^4(-3x)+\binom{5}{2}2^3(-3x)^2+\ldots, \quad \ldots\ldots$	M1
	$=32, \ -240x, \ +720x^2$	B1, A1, A1
		Total 4
Notes	**M1**: The **method** mark is awarded for an attempt at Binomial to get the second and/or third term – need **correct** binomial coefficient combined **with correct power of *x*.** Ignore errors (or omissions) in powers of 2 or 3 or sign or bracket errors. Accept any notation for ${}^5C_1$ and ${}^5C_2$, e.g. $\binom{5}{1}$ and $\binom{5}{2}$ (unsimplified) or 5 and 10 from Pascal's triangle This mark may be given if no working is shown, but either or both of the terms including x is correct. **B1:** must be simplified to 32 (writing just 2^5 is **B0). 32** must be the only constant term in the final answer- so 32 +80 - 3*x*+80 +9 x^2 is B0 but may be eligible for M1A0A0 . **A1: is cao and is for** –240 *x*. (not +-240x) The *x* is required for this mark **A1:** is c.a.o and is for $720x^2$ (can follow omission of negative sign in working) A list of correct terms may be given credit i.e. series appearing on different lines Ignore extra terms in x^3 and/or x^4 (isw)	
Special Case	Special Case*: Descending powers* of x would be $(-3x)^5+2\times5\times(-3x)^4+2^2\times\binom{5}{3}\times(-3x)^3+\ldots$ i.e. $-243x^5+810x^4-1080x^3+\ldots$ This is a misread but award as s.c. M1B1A0A0 if completely "correct" or M1 B0A0A0 for <u>correct</u> binomial coefficient in any form with the correct power of x	
Alternative Method	**Method 1:** $\left[(2-3x)^5\right]=2^5(1+\binom{5}{1}(-\frac{3x}{2})+\binom{5}{2}(\frac{-3x}{2})^2+\ldots\ )$ is **M1B0A0A0 {** The M1 is for the expression **in the bracket** and as in first method– need **correct** binomial coefficient combined with correct power of *x*. Ignore bracket errors or errors (or omissions) in powers of 2 or 3 or sign or bracket errors} – answers must be simplified to $=32,-240x,+720x^2$ for full marks (awarded as before) $\left[(2-3x)^5\right]=2(1+\binom{5}{1}(-\frac{3x}{2})+\binom{5}{2}(\frac{-3x}{2})^2+\ldots\ )$ would also be awarded **M1B0A0A0** **Method 2: Multiplying out** : B1 for 32 and M1A1A1 for other terms with M1 awarded if *x* or *x*^2 term is correct. Completely correct is 4/4	

Jan 2010 Mathematics Advanced Paper 1: Pure Mathematics 2

9.

Question Number	Scheme	Marks
Q1	$\left[(3-x)^6=\right]3^6+3^5\times6\times(-x)+3^4\times\binom{6}{2}\times(-x)^2$ $=729,\quad -1458x,\quad +1215x^2$	M1 B1,A1, A1 **[4]**
Notes	**M1** for <u>either</u> the x term <u>or</u> the x^2 term. Requires <u>correct</u> binomial coefficient in any form with the correct power of x – condone lack of negative sign and wrong power of 3. This mark may be given if no working is shown, but one of the terms including x is correct. Allow $\frac{6}{1}$, or $\frac{6}{2}$ (must have a power of 3, even if only power 1) First term must be 729 for **B1**, (writing just 3^6 is **B0**) can isw if numbers added to this constant later. Can allow 729(1… Term must be simplified to $-1458x$ for **A1cao.** The x is required for this mark. **Final A1** is c.a.o and needs to be $+1215x^2$ (can follow omission of negative sign in working) Descending powers of x would be $x^6+3\times6\times(-x)^5+3^2\times\binom{6}{4}\times(-x)^4+..$ i.e. $x^6-18x^5+135x^4+..$ This is M1B1A0A0 if completely "correct" or M1 B0A0A0 for <u>correct</u> binomial coefficient in any form with the correct power of x as before	
Alternative	**NB Alternative method:** $(3-x)^6=3^6(1+6\times(-\frac{x}{3})+\binom{6}{2}\times(-\frac{x}{3})^2+..)$ is **M1B0A0A0** – answers must be simplified to 729, $-1458x$, $+1215x^2$ for full marks (awarded as before) The mistake $(3-x)^6=3(1-\frac{x}{3})^6=3(1+6\times(-\frac{x}{3})+\times\binom{6}{2}\times(-\frac{x}{3})^2+..)$ may also be awarded **M1B0A0A0** Another mistake $3^6(1-6x+15x^2...)=729...$ would be M1B1A0A0	