Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
1	Correctly shows that either f(3) = 0, f(−2) = 0 or $\mathrm{f}\left(-\frac{1}{2}\right) = 0$	**M1**	3.1a	4th Divide polynomials by linear expressions with no remainder
	Draws the conclusion that (x – 3), (x + 2) or (2x + 1) must therefore be a factor.	**M1**	2.2a	
	Either makes an attempt at long division by setting up the long division, or makes an attempt to find the remaining factors by matching coefficients. For example, stating $(x-3)(ax^2+bx+c)=2x^3-x^2-13x-6$ or $(x+2)(rx^2+px+q)=2x^3-x^2-13x-6$ or $(2x+1)(ux^2+vx+w)=2x^3-x^2-13x-6$	**M1**	1.1b	
	For the long division, correctly finds the the first two coefficients. For the matching coefficients method, correctly deduces that a = 2 and c = 2 or correctly deduces that r = 2 and q = −3 or correctly deduces that u = 1 and w = –6	**A1**	2.2a	
	For the long division, correctly completes all steps in the division. For the matching coefficients method, correctly deduces that b = 5 or correctly deduces that p = −5 or correctly deduces that v = –1	**A1**	1.1b	
	States a fully correct, fully factorised final answer: (x – 3)(2x + 1)(x + 2)	**A1**	1.1b	
				(6 marks)

Notes

Other algebraic methods can be used to factorise h(x). For example, if (x – 3) is known to be a factor then

$2x^3 - x^2 - 13x - 6 = 2x^2(x-3) + 5x(x-3) + 2(x-3)$ by balancing (M1)

$= (2x^2 + 5x + 2)(x-3)$ by factorising (M1)

$= (2x+1)(x+2)(x-3)$ by factorising (A1)

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
2a	States or implies the expansion of a binomial expression to the 8th power, up to and including the x^3 term. $(a+b)^8 = {}^8C_0a^8 + {}^8C_1a^7b + {}^8C_2a^6b^2 + {}^8C_3a^5b^3 + \ldots$ or $(a+b)^8 = a^8 + 8a^7b + 28a^6b^2 + 56a^5b^3 + \ldots$	**M1**	1.1a	5th Understand and use the general binomial expansion for positive integer n
	Correctly substitutes 1 and 3*x* into the formula: $(1+3x)^8 = 1^8 + 8\times1^7\times3x + 28\times1^6\times(3x)^2 + 56\times1^5\times(3x)^3 + \ldots$	**M1**	1.1b	
	Makes an attempt to simplify the expression (2 correct coefficients (other than 1) or both $9x^2$ and $27x^3$). $(1+3x)^8 = 1^8 + 24x + 28\times9x^2 + 56\times27x^3 + \ldots$	**M1 dep**	1.1b	
	States a fully correct answer: $(1+3x)^8 = 1 + 24x + 252x^2 + 1512x^3 + \ldots$	**A1**	1.1b	
		(4)		
2b	States $x = 0.01$ or implies this by attempting the substitution: $1 + 24(0.01) + 252(0.01)^2 + 1512(0.01)^3 + \ldots$	**M1**	2.2a	5th Find approximations using the binomial expansion for positive integer n
	Attempts to simplify this expression (2 calculated terms correct): 1 + 0.24 + 0.0252 + 0.001512	**M1**	1.1b	
	1.266712 = 1.2667 (5 s.f.)	**A1**	1.1b	
		(3)		
				(7 marks)

Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
3a	States or implies the expansion of a binomial expression to the 9th power, up to and including the x^3 term. $(a+b)^9 = {}^9C_0a^9 + {}^9C_1a^8b + {}^9C_2a^7b^2 + {}^9C_3a^6b^3 + \ldots$ or $(a+b)^9 = a^9 + 9a^8b + 36a^7b^2 + 84a^6b^3 + \ldots$	**M1**	1.1a	5th Use the binomial expansion to find arbitrary terms for positive integer n
	Correctly substitutes 2 and *px* into the formula. $(2+px)^9$ $= 2^9 + 9\times 2^8 \times px + 36\times 2^7 \times (px)^2 + 84\times 2^6 \times (px)^3 + \ldots$	**M1**	1.1b	
	Makes an attempt to simplify the expression (at least one power of 2 calculated and one bracket expanded correctly). $(2+px)^9 = 512 + 9\times 256\times px + 36\times 128\times p^2x^2 + 84\times 64\times p^3x^3 + \ldots$	**M1dep**	1.1b	
	States a fully correct answer: $(2+px)^9 = 512 + 2304px + 4608p^2x^2 + 5376p^3x^3 + \ldots$	**A1**	1.1b	
		(4)		
3bi	States that $5376p^3 = -84$	**M1ft**	2.2a	5th Understand and use the general binomial expansion for positive integer n
	Correctly solves for *p*: $p^3 = -\frac{1}{64} \Rightarrow p = -\frac{1}{4}$	**A1ft**	1.1b	
3bii	Correctly find the coefficient of the *x* term: $2304\left(-\frac{1}{4}\right) = -576$	**B1ft**	1.1b	5th Understand and use the general binomial expansion for positive integer n
	Correctly find the coefficient of the x^2 term: $4608\left(-\frac{1}{4}\right)^2 = 288$	**B1ft**	1.1b	
		(4)		
				(8 marks)

Notes
ft marks – pursues a correct method and obtains a correct answer or answers from their 5376 from part **a**.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
4a	Attempt is made at expanding $(p+q)^5$. Accept seeing the coefficients 1, 5, 10, 10, 5, 1 or seeing $(p+q)^5 = {}^5C_0 p^5 + {}^5C_1 p^4 q + {}^5C_2 p^3 q^2 + {}^5C_3 p^2 q^3 + {}^5C_4 p q^4 + {}^5C_5 q^5$ o.e.	**M1**	1.1a	5th Understand and use the general binomial expansion for positive integer n
	Fully correct answer is stated: $(p+q)^5 = p^5 + 5p^4q + 10p^3q^2 + 10p^2q^3 + 5pq^4 + q^5$	**A1**	1.1b	
		(2)		
4b	States that p, or the probability of rolling a 4, is $\frac{1}{4}$	**B1**	3.3	5th Use the binomial expansion to find arbitrary terms for positive integer n
	States that q, or the probability of not rolling a 4, is $\frac{3}{4}$	**B1**	3.3	
	States or implies that the sum of the first 3 terms (or 1 − the sum of the last 3 terms) is the required probability. For example, $p^5 + 5p^4q + 10p^3q^2$ or $1 - (10p^2q^3 + 5pq^4 + q^5)$	**M1**	2.2a	
	$\left(\frac{1}{4}\right)^5 + 5\left(\frac{1}{4}\right)^4\left(\frac{3}{4}\right) + 10\left(\frac{1}{4}\right)^3\left(\frac{3}{4}\right)^2$ or $\frac{1}{1024} + \frac{15}{1024} + \frac{90}{1024}$ or $1 - \left(10\left(\frac{1}{4}\right)^2\left(\frac{3}{4}\right)^3 + 5\left(\frac{1}{4}\right)\left(\frac{3}{4}\right)^4 + \left(\frac{3}{4}\right)^5\right)$ or $1 - \left(\frac{270}{1024} + \frac{405}{1024} + \frac{243}{1024}\right)$	**M1**	1.1b	
	Either $\frac{53}{512}$ o.e. or awrt 0.104	**A1**	1.1b	
		(5)		

(7 marks)
Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
5a	Makes an attempt to interpret the meaning of f(5) = 0. For example, writing 125 + 25 + 5p + q = 0	**M1**	2.2a	5th Solve non-linear simultaneous equations in context
	5p + q = −150	**A1**	1.1b	
	Makes an attempt to interpret the meaning of f(−3) = 8. For example writing −27 + 9 – 3p + q = 8	**M1**	2.2a	
	−3p + q = 26	**A1**	1.1b	
	Makes an attempt to solve the simultaneous equations.	**M1ft**	1.1a	
	Solves the simultaneous equations to find that p = −22	**A1ft**	1.1b	
	Substitutes their value for p to find that q = −40	**A1ft**	1.1b	
		(7)		
5b	Draws the conclusion that (x – 5) must be a factor.	**M1**	2.2a	5th Divide polynomials by linear expressions with a remainder
	Either makes an attempt at long division by setting up the long division, or makes an attempt to find the remaining factors by matching coefficients. For example, stating: $(x-5)(ax^2+bx+c)=x^3+x^2-22x-40$ (ft their −22 or −40)	**M1ft**	1.1b	
	For the long division, correctly finds the the first two coefficients. For the matching coefficients method, correctly deduces that a = 1 and c = 8	**A1**	2.2a	
	For the long division, correctly completes all steps in the division. For the matching coefficients method, correctly deduces that b = 6	**A1**	1.1b	
	States a fully correct, fully factorised final answer: (x – 5)(x + 4)(x + 2)	**A1**	1.1b	
		(5)		

(12 marks)
Notes Award ft through marks for correct attempt/answers to solving their simultaneous equations. In part **b** other algebraic methods can be used to factorise: $x - 5$ is a factor (M1) $x^3 - x^2 - 22x - 40 = x^2(x-5) + 6x(x-5) + 8(x-5)$ by balancing (M1) $= (x^2 + 6x + 8)(x-5)$ by factorising (M1) $= (x+4)(x+2)(x-5)$ by factorising (A1 A1) (i.e. A1 for each factor other than (x – 5))

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
6	Considers the expression $x^2+\frac{13}{2}x+16$ either on its own or as part of an inequality/equation with 0 on the other side.	**M1**	3.1a	6th Complete algebraic proofs in unfamiliar contexts using direct or exhaustive methods
	Makes an attempt to complete the square. For example, stating: $\left(x+\frac{13}{4}\right)^2-\frac{169}{16}+\frac{256}{16}$ (ignore any (in)equation)	**M1**	1.1b	
	States a fully correct answer: $\left(x+\frac{13}{4}\right)^2+\frac{87}{16}$ (ignore any (in)equation)	**A1**	1.1b	
	Interprets this solution as proving the inequality for all values of *x*. Could, for example, state that $\left(x+\frac{13}{4}\right)^2\geq 0$ as a number squared is always positive or zero, therefore $\left(x+\frac{13}{4}\right)^2+\frac{87}{16}>0$. Must be logically connected with the statement to be proved; this could be in the form of an additional statement. So $x^2+6x+18>2-\frac{1}{2}x$ (for all *x*) or by a string of connectives which must be equivalent to "if and only if"s.	**A1**	2.1	
		(4)		

(4 marks)

Notes

Any correct and complete method (e.g. finding the discriminant and single value, finding the minimum point by differentiation or completing the square and showing that it is both positive and a minimum, sketching the graph supported with appropriate methodology etc) is acceptable for demonstrating that $x^2+\frac{13}{2}x+16>0$ for all *x*.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
7a	Makes an attempt to expand the binomial expression $(1+x)^3$ (must be terms in x^0, x^1, x^2, x^3 and at least 2 correct).	**M1**	1.1a	6th Solve problems using the binomial expansion (for positive integer n) in unfamiliar contexts (including the link to binomial probabilities)
	$1+3x^2+x^3<1+3x+3x^2+x^3$	**A1**	1.1b	
	$0 < 3x$	**A1**	1.1b	
	$x > 0$* as required.	**A1***	2.2a	
		(4)		
7b	Picks a number less than or equal to zero, e.g. $x=-1$, and attempts a substitution into both sides. For example, $1+3(-1)^2+(-1)^3<1+3(-1)+3(-1)^2+(-1)^3$	**M1**	1.1a	5th Use the binomial expansion to find arbitrary terms for positive integer n
	Correctly deduces for their choice of x that the inequaltity does not hold. For example, $3 \nless 0$	**A1**	2.2a	
		(2)		
				(6 marks)

Notes