

	Introduce	Strengthen	Deepen
Surd	Q1 $5 + \sqrt{35}$	Q1 $74 - 40\sqrt{3}$	Q1 $16\sqrt{7}$
	Q2 $\frac{\sqrt{30}}{3}$	Q2 $\frac{1 + 5\sqrt{3}}{10}$	Q2 $6 + 3\sqrt{11}$
	Q3 $11 + 7\sqrt{5}$	Q3 $3\sqrt{7} - 7$	Q3 $5\sqrt{h} - 1$
	Q4 $61 + 27\sqrt{3}$	Q4 $13\sqrt{3}$	Q4 $\frac{9\sqrt{3} - 13}{2}$
	Q5 $\frac{\sqrt{2} + 2}{2}$		
Expanding brackets	Q1 $m^2 + 11m + 18$	Q1 $24d^2 + 38d + 10$	Q1 $40x^3 + 38x^2 - 131x + 60$
	Q2 $8a^2 + 22a + 15$	Q2 $x^3 + 4x^2 + 8x + 5$	Q2 $a = 5, b = -3, c = 6$
	Q3 $4x^2 - 3x - 27$	Q3 $15n^2 + 31n + 43$	Q3 $\frac{1}{125x^3} + \frac{1}{64y^3}$
	Q4 $36n^2 - 60n + 25$	Q4 $t^3 - t^2 - 22t + 40$	Q4 Equivalence correctly shown, for example through expanding brackets and simplifying both sides of the equivalence.
Factorising quadratics	Q1 $(y + 4)(y + 5)$	Q1 $(x + 4)(x - 4)$	Q1 $(7h + m)(7h - m)$
	Q2 $(x + 4)(x - 5)$	Q2 $(2r + 1)(r + 7)$	Q2 $(5 - b)(b - 2)$
	Q3 $(w - 6)(w - 9)$	Q3 $(5x + 2)(x + 4)$	Q3 $10n(2k - 5n)$
Simplifying expressions	Q1 $12y^7$		
	Q2 $\frac{1}{h^{15}}$	Q1 $\frac{a}{6k}$	Q1 $a = 3, b = 21, c = 24$
	Q3 $\frac{t^3u}{4}$	Q2 $8g^4h^2$	Q2 $8nr^3(t + 6)$
	Q4 $\frac{t^6}{u^{10}}$	Q3 $\frac{1}{2x - 35}$	Q3 $a = 2, b = -3, c = -20, d = 4$
	Q5 $\frac{11y + 3}{6}$		
	Q6 $\frac{6}{a + 4}$		

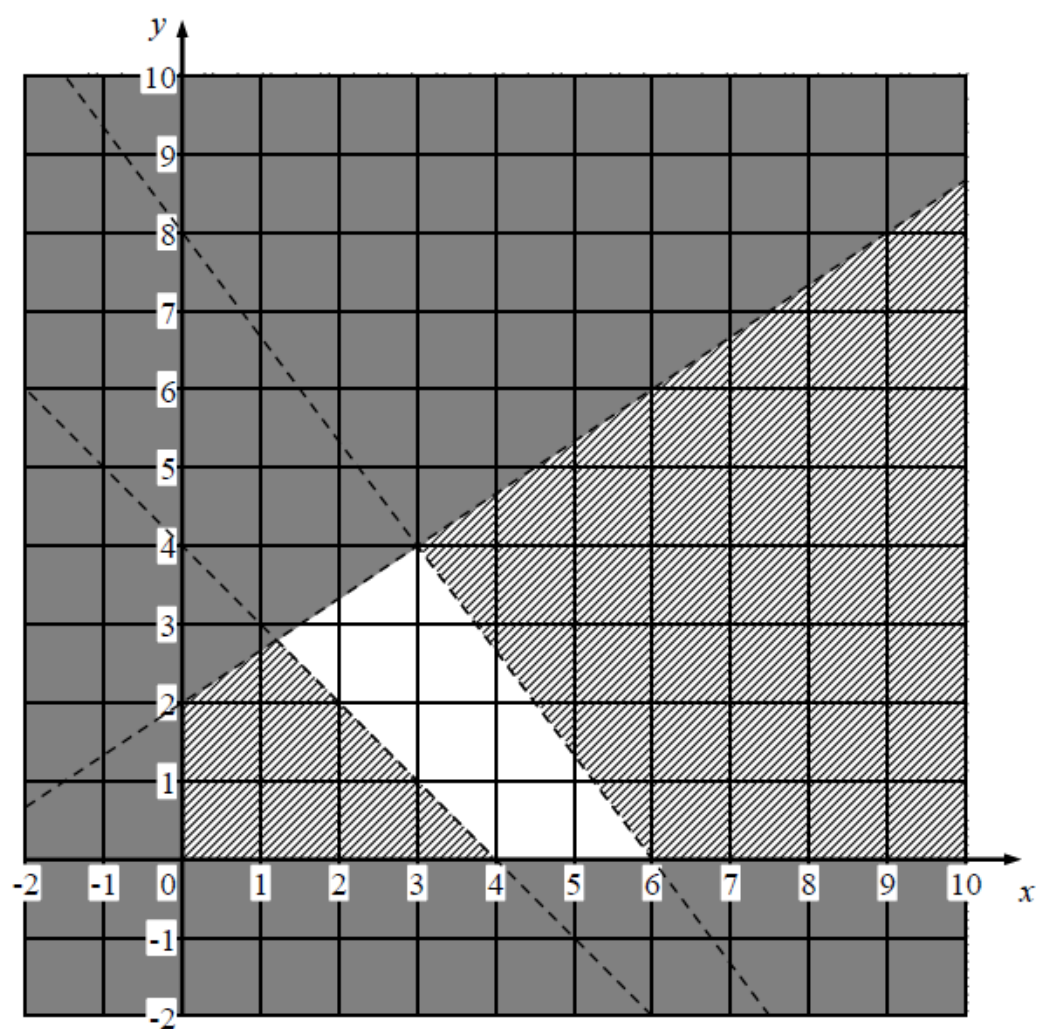
	Introduce	Strengthen	Deepen
Operations with algebraic fractions	Q1 $7a$ Q2 $\frac{15}{v}$ Q3 $\frac{37n + 14}{35}$	Q1 $\frac{18}{a}$ Q2 $\frac{5x - 1}{(5x - 7)(x + 1)}$ Q3 $\frac{x - 4}{2x(x + 5)}$ Q4 $\frac{7ab}{5k}$	Q1 $\frac{3x - 11}{(6 - x)(6 + x)}$ Q2 $\frac{5x + 49}{x + 7}$
Solving quadratic equations	Q1 $x = 9$ and $x = -5$ Q2 $y = 2$ and $y = -5$ Q3 $w = 2$ and $w = 6$ Q4 $x = \frac{-5}{2}$ and $x = \frac{-3}{2}$ Q5 $m = \frac{1}{2}$ and $m = 5$	Q1 $y = 3 \pm \sqrt{2}$ Q2 $y = \frac{-2}{3}$ and $y = \frac{5}{2}$ Q3 $y = \frac{-7}{2}$ and $y = \frac{5}{3}$ Q4 $r = -0.15$ and $r = 1.48$	Q1 $x = -2$ and $x = 18$ Q2 $n = \frac{2}{5}$ Q3 $y = \frac{-1}{2}$ and $y = 3$ Q4 $b = 3, c = -5$
Quadratic graphs	Q1 $(2, 0)$ and $(6, 0)$ Q2 $x = -2.8$ and $x = 1.8$ Q3 $x = -2$ and $x = 1$ Q4 a) $(x + 3)^2 + 2$ b) $(-3, 2)$	Q1 $(-4, -26)$ Q2 $\left(\frac{5}{2}, \frac{-21}{4}\right)$ Q3 $(1, -13)$ Q4 $x = -1$ and $x = 2.5$	Q1 5 Q2 $a = -10, b = 29$ Q3 a) $(8, -1)$ b) 0
Linear simultaneous equations	Q1 $x = 3, y = 4$ Q2 $x = 4, y = 2$ Q3 $a = 3, b = 5$ Q4 $x = 1, y = 2$	Q1 $x = -1, y = 3$ Q2 $x = 9, y = -7$ Q3 $x = \frac{1}{2}, y = \frac{3}{2}$ Q4 $t = 5, u = 10$	Q1 $x = 5, y = -3$ Q2 $x = 3, y = 4, a = 1$ Q3 $x = 4, y = 1$ Q4 $x = 6, y = 2$
Straight-line graphs	Q1 $y = -5x + 3$ Q2 $y = \frac{4}{7}x + 5$ Q3 $-\frac{1}{8}$ Q4 $y = 3x + 4$ Q5 $y = 5x - 7$	Q1 $y = \frac{-3}{4}x + 36$ Q2 $y = \frac{1}{3}x + 4$ Q3 $y = 3x - 10$ Q4 $y = 3x + 5$	Q1 $\frac{h}{4}$ Q2 $(12, 4)$ Q3 7:10 Q4 $y = \frac{1}{2}x - 15$

	Introduce	Strengthen	Deepen
Right-angled trigonometry	Q1 4.2 mm Q2 4.5 cm Q3 49°	Q1 18.28 m Q2 40.2° Q3 61.9°	Q1 45.9° Q2 15.62 cm Q3 79° Q4 10.91 cm
Further trigonometry	Q1 11.7 cm Q2 10.1 m Q3 41.7° Q4 77°	Q1 3.2 cm Q2 85.6°	Q1 2.2 cm Q2 $(4 + 7\sqrt{6})$ cm Q3 30 Q4 $a = 16, b = 3, c = 9$

Mark Scheme

Q1.

Question	Working	Answer	Mark	Notes
(a)		3, 4	1	B1
(b)		see graph at end of mark scheme	3	B3 for correct region identified If not B3 then award B2 for $x + y = 4$ drawn (with no additional lines drawn) and a region identified that satisfies at least 3 of the 5 given inequalities If not B2 then award B1 for line $x + y = 4$ drawn NB. May shade wanted or unwanted regions; lines may be solid or dashed



Q2.

Question number	Working	Answer	Mark	Notes
	$2x^2 = 20 - 3x$ May be implied by second M1		5	M1 $y = 2\left(\frac{20-y}{3}\right)^2$ May be implied by second M1
	$2x^2 + 3x - 20 (= 0)$			M1 $2y^2 - 89y + 800 (= 0)$
	$(2x - 5)(x + 4) (= 0)$ or $2x(x + 4) - 5(x + 4) (= 0)$ or $x(2x - 5) + 4(2x - 5) (= 0)$ or $-3 \pm \sqrt{3^2 - 4 \times 2 \times (-20)}$ $\frac{2 \times 2}{-3 \pm \sqrt{9 + 160}}$ or $\frac{-3 \pm \sqrt{169}}{4}$ or $\frac{-3 \pm \sqrt{169}}{4}$ or $\frac{-3 \pm 13}{4}$			M1 $(2y - 25)(y - 32) (= 0)$ or $2y(y - 32) - 25(y - 32) (= 0)$ or $y(2y - 25) - 32(2y - 25) (= 0)$ or $\frac{89 \pm \sqrt{(-89)^2 - 4 \times 2 \times 800}}{2 \times 2}$ or $\frac{89 \pm \sqrt{7921 - 6400}}{4}$ or $\frac{89 \pm \sqrt{1521}}{4}$ or $\frac{89 \pm 39}{4}$
		$x = \frac{5}{2}, x = -4$		A1 $y = \frac{25}{2}, y = 32$ dep on all method marks
		$x = \frac{5}{2}, y = \frac{25}{2}$ $x = -4, y = 32$		A1 $x = \frac{5}{2}, y = \frac{25}{2}$ $x = -4, y = 32$ dep on all preceding marks Accept answers given as coordinates
				Total 5 marks

Q3.

Q	Working	Answer	Mark	Notes
	eg $2(-3-2x)^2 + x^2 = -6x + 42$	eg $2y^2 + \left(\frac{-3-y}{2}\right)^2 = -6\left(\frac{-3-y}{2}\right) + 42$	5	M1 substitution of $y = \pm 3 \pm 2x$ (or $x = \frac{\pm 3 \pm y}{2}$) into $2y^2 + x^2 = -6x + 42$ to obtain an equation in x only (or y only)
	eg $9x^2 + 30x - 24 (= 0)$ or $3x^2 + 10x - 8 (= 0)$ allow eg $3x^2 + 10x = 8$	eg $\frac{9}{4}y^2 - \frac{3}{2}y - \frac{195}{4} (= 0)$ or $9y^2 - 6y - 195 (= 0)$ or $3y^2 - 2y - 65 (= 0)$ allow eg $3y^2 - 2y = 65$		M1 ft (dep on previous M1) for multiplying out and collecting terms, forming a three term quadratic in any form of $ax^2 + bx + c (= 0)$ where at least 2 coefficients (a or b or c) are correct
	eg $(3x-2)(x+4) (= 0)$ or $\frac{-10 \pm \sqrt{10^2 - 4 \times 3 \times -8}}{2 \times 3}$ or $3\left[\left(x + \frac{5}{3}\right)^2 - \left(\frac{5}{3}\right)^2\right] = 8$ oe (should give $(x =) \frac{2}{3}, -4$)	eg $(3y+13)(y-5) (= 0)$ or $\frac{2 \pm \sqrt{(-2)^2 - 4 \times 3 \times -65}}{2 \times 3}$ or $3\left[\left(y - \frac{1}{3}\right)^2 - \left(\frac{1}{3}\right)^2\right] = 65$ oe (should give $(y =) -\frac{13}{3}, 5$)		M1 ft (dep on M1) method to solve their 3 term quadratic using any correct method (allow one sign error and some simplification – allow as far as eg $\frac{-10 \pm \sqrt{100+96}}{6}$ or $\frac{2 \pm \sqrt{4+780}}{6}$) or if factorising allow brackets which expanded give 2 out of 3 terms correct) or correct values for x (allow 0.66(6...) or 0.67) or correct values for y (allow -4.33(3...))

eg $2\left(\frac{2}{3}\right) + y = -3$ and $2(-4) + y = -3$	eg $2x + \frac{13}{3} = -3$ and $2x + 5 = -3$		M1 (dep on previous M1) for substituting their 2 found values of x or y in a suitable equation (use 2dp or better for substitution) or fully correct values for the other variable (correct labels for x/y)
Working required		$x = -4, y = 5$ and $x = \frac{2}{3}, y = -\frac{13}{3}$	A1 oe (dep on M1) and a correct quadratic (allow coordinates) allow $x = 0.66(6...)$ or 0.67, $y = -4.33(3...)$, $x = -4, y = 5$
Total 5 marks			

Q4.

Q	Working		Answer	Mark	Notes
	$y = x - 3$	$x = y + 3$		6	B1 for correct rearrangement of linear equation
	eg $3x^2 - (x - 3)^2 + x(x - 3) = 9$	eg $3(3 + y)^2 - y^2 + y(3 + y) = 9$			M1 substitution of their linear equation into quadratic in x or y alone (even if B0 scored)
	eg $3x^2 + 3x - 18 (= 0)$ or $x^2 + x - 6 (= 0)$	eg $3y^2 + 21y + 18 (= 0)$ or $y^2 + 7y + 6 (= 0)$			M1ft from their substitution (dep on previous M1) for a complete correct method to get a 3-term or 2-term quadratic expression in the form $ax^2 + bx (+ c) (= 0)$ [allow $ax^2 + bx = c$]
	eg $(x - 2)(x + 3) (= 0)$ $x = \frac{-1 \pm \sqrt{1^2 - 4 \times 1 \times -6}}{2 \times 1}$ eg $\left(x - \frac{1}{2}\right)^2 - \left(\frac{1}{2}\right)^2 = 6$	eg $(y + 1)(y + 6) (= 0)$ $y = \frac{-7 \pm \sqrt{7^2 - 4 \times 1 \times 6}}{2 \times 1}$ eg $\left(y - \frac{7}{2}\right)^2 - \left(\frac{7}{2}\right)^2 = -6$			M1 (dep on M1) for a complete method to solve their 3-term or 2-term quadratic equation ($ax^2 + bx (+ c) = 0$) – correct factorisation or substitution into formula or completing square (allow one sign error and some simplification – allow as far as $\frac{-1 \pm \sqrt{1 + 24}}{2}$ or $\frac{-7 \pm \sqrt{49 - 24}}{2}$) or for seeing $x = 2, x = -3$ or $y = -1, y = -6$
	$x = -3, x = 2$ and $y = -1, y = -6$ or one correct midpoint coordinate ie $x = -\frac{1}{2}$ or $y = -\frac{7}{2}$				A1 (dep on M2) for $x = 2, x = -3$ and $y = -1, y = -6$ or one correct midpoint ie $x = -\frac{1}{2}$ or $y = -\frac{7}{2}$
	Working required		$\left(-\frac{1}{2}, -\frac{7}{2}\right)$		A1 (dep on M2) oe
					Total 6 marks

Q5.

(a)	$-4x > 17 - 9$ or $-4x > 8$ or $9 - 17 > 4x$ or $-8 > 4x$ or $\frac{9}{4} - x > \frac{17}{4}$ oe or $-\frac{9}{4} + x < -\frac{17}{4}$ oe		2	M1 for a correct first step Condone = rather than $>$ or any other sign for this mark.
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$x < -2$		A1 oe eg $-2 > x$ (sight of correct answer in working space and just $(x =) -2$ on answer line
(b)		$y \geq 2$ $x \leq 6$ $y \leq x$	3	B3 for all 3 correct Allow $2 \leq y, 6 \geq x$ and $x \geq y$ B2 for 2 correct B1 for 1 correct Allow $<$ and $>$ signs SCB2: $y \leq 2, y \geq x$ and $x \geq 6$ Allow $<$ and $>$ signs
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>			Total 5 marks

Q6.

Q	Working	Answer	Mark	Notes
(i)	$-7 + 3 \leq 2x < 5 + 3$ oe or $\frac{-7}{2} \leq x - \frac{3}{2} < \frac{5}{2}$ oe or $-7 + 3 \leq 2x$ oe and $2x < 5 + 3$ oe or $(x =) -2$ or $(x =) 4$		3	M1 or one side of the inequality correct, i.e. $x \geq -2$ oe or $x < 4$ Condone = rather than $\leq$ or $<$ or any other sign for the M marks.
	$\frac{-7+3}{2} \leq x < \frac{5+3}{2}$ or $\frac{-7}{2} + \frac{3}{2} \leq x < \frac{5}{2} + \frac{3}{2}$ or $\frac{-7+3}{2} \leq x$ oe and $x < \frac{5+3}{2}$ or $(x =) -2$ and $(x =) 4$			M1
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$-2 \leq x < 4$		A1 allow $x \geq -2$ and $x < 4$ Allow $[-2, 4)$
(ii)			2	M1 ft for drawing a line from -2 to 4 or (indep) for a closed circle or $[$ at -2 or (indep) for an open circle or $)$ or $[$ at 4 Only allow a follow through for a double ended inequality
		Correct diagram		A1 ft for correct diagram Only allow a follow through for a double ended inequality
				Total 5 marks

Q7.

Q	Working	Answer	Mark	Notes
	$(10x + 21)(x - 1)$ or $\frac{-11 \pm \sqrt{(11)^2 - 4 \times 10 \times -21}}{2 \times 10}$ $10 \left[\left(x + \frac{11}{20} \right)^2 - \frac{121}{400} \right]$ $-21 (= 0)$ oe		3	M1 A correct method to solve the quadratic; correct factors or correct substitution into the formula or can be simplified as far as $\frac{-11 \pm \sqrt{121 + 840}}{20}$ or correctly completing the square. (10)(x + 2.1)(x - 1) is not a correct factorisation – it is working backwards from calculator answers.
	(x =) 1, (x =) -2.1			A1 dep on M1 for correct critical values
	<i>Working required</i>	$-2.1 < x < 1$		A1 dep on M1 oe eg $x > -2.1$ (and) $x < 1$ (do not penalise 'or') or $\frac{-21}{10} < x < 1$ etc including the open interval $(-2.1, 1)$ or $] -2.1, 1[$
				Total 3 marks

Q8.

Q	Working	Answer	Mark	Notes	
	eg $(2x+3)(x-5)$ oe or $\frac{- -7 \pm \sqrt{(-7)^2 - 4 \times 2 \times (-15)}}{2 \times 2}$ oe or $2 \left[\left(x - \frac{7}{4} \right)^2 - \left(\frac{7}{4} \right)^2 \right] - 15$ oe		3	M1 for a correct method to find the critical values Minimum evidence for quadratic formula is a two-term discriminant, eg $\frac{7 \pm \sqrt{49 + 120}}{4}$ (must have the $\pm$) Allow $(x + 1.5)(2x - 10)$ as a correct factorisation, but do not allow $\left(x + \frac{3}{2} \right)(x - 5)$ unless preceded by division of the quadratic by 2	Allow M1A1 for the correct critical values AND evidence of another algebraic method that has led to these: eg $x(2x + 3) - 5(2x + 3)$ and the correct critical values or $2x(x - 5) + 3(x - 5)$ and the correct critical values or $(2x + 3)(2x - 10)$ and the correct critical values
	$\left(x = \right) -\frac{3}{2}$ and $\left(x = \right) 5$			A1 dep on M1 for correct critical values oe	

		Working required	$x < -\frac{3}{2},$ $x > 5$		A1 dep on M1 for correct inequalities (must be separate inequalities) allow interval notation eg $\left(-\infty, -\frac{3}{2}\right) \cup (5, \infty)$ or $\left(-\infty, -\frac{3}{2}\right), (5, \infty)$ or $\left]-\infty, -\frac{3}{2}\right[\cup]5, \infty[$ or $\left]-\infty, -\frac{3}{2}\right[,]5, \infty[$ Acceptable notation: allow a comma, space, “or”, “and” or “ $\cup$ ” to link the two regions Do not allow as a single inequality $-\frac{3}{2} > x > 5$
					Total 3 marks

Q9.

Q	Working	Answer	Mark	Notes
	$(2x + 3)(x - 1) < 75$		5	B1 For writing the correct inequality sign with a correct calculation or correct value – this could be initially or saying that $x < 6$ at the end
	$2x^2 + x - 78 < 0$			M1 rearranged to form correct quadratic < 0 (allow $= 0$ or other incorrect inequality sign) oe
	$(x - 6)(2x + 13) (< 0)$ or $x = \frac{-1 \pm \sqrt{(1)^2 - (4 \times 2 \times -78)}}{2 \times 2}$ or $2\left(x + \frac{1}{4}\right)^2 - 2\left(\frac{1}{4}\right)^2 - 78 = 0$			M1 first step to find critical values from the correct quadratic
		$x = 6$		A1 $x = 6$ identified as critical value, ignore -6.5 if given
		$1 < x < 6$		A1 correct inequality
				Total 5 marks

Q10.

Question	Working	Answer	Mark	Notes
(a)		1	1	B1
(b)		$27x^6y^{15}$	2	B2 If not B2 then B1 for any two correct terms in a product
(c)	$2(e^2 - 9)$ or $(2e - 6)(e + 3)$ or $(e - 3)(2e + 6)$			M1
(d)	$m^2 = \frac{6a+r}{5r}$ $m^2 \times 5r = 6a + r$ $5rm^2 - r = 6a$	$2(e - 3)(e + 3)$	2	A1 M1
		$r = \frac{6a}{5m^2 - 1}$	4	A1 or for $r = \frac{-6a}{1 - 5m^2}$ oe NB: to award A1 we must see $r = \frac{6a}{5m^2 - 1}$ in working if $\frac{6a}{5m^2 - 1}$ alone is given as answer

Q11.

Q	Working	Answer	Mark	Notes
(a)		$-\frac{4}{3}$	1	B1
(b)	$3(x^2 + 4x) + 19$ and $3[(x + 2)^2 - 2^2] + 19$ or $3\left(x^2 + 4x + \frac{19}{3}\right)$ and $3\left((x + 2)^2 - 2^2 + \frac{19}{3}\right)$ or $a = 3$ and $2ab = 12$ oe and $b^2a + c = 19$ oe or $a = 3$ and $b = \frac{12}{2 \times 3}$ oe and $c = -\frac{12^2}{4 \times 3} + 19$ oe			M1 for correctly taking out a factor of 3 and correctly completing the square or for equating coefficients by expanding $a(x + b)^2 + c = ax^2 + 2abx + b^2a + c$ or for equating coefficients by using $ax^2 + bx + c = a\left(x + \frac{b}{2a}\right)^2 - \frac{b^2}{4a} + c$
		$3(x + 2)^2 + 7$		A1 accept $a = 3, b = 2, c = 7$
				Total 3 marks

Q12.

Q	Working	Answer	Mark	Notes
(a)	eg $12 \times \frac{5a+8}{3} - 12 \times \frac{2a+5}{4} = 12 \times 23$ or eg $4(5a+8) - 3(2a+5) = 12 \times 23 (= 276)$ or eg $\frac{4(5a+8)}{12} - \frac{3(2a+5)}{12} (= 23)$ or eg $\frac{4(5a+8) - 3(2a+5)}{12} (= 23)$		4	M1 for clear intention to multiply all terms by 12 or a multiple of 12 or to express LHS as two fractions over 12 or a multiple of 12 or as a single fraction with a denominator of 12 or a multiple of 12 (If expanded numerator, allow one sign error or one numerical error but not both) Accept $\frac{20a+32}{12} - \frac{6a+15}{12} (= 23)$ or $\frac{20a+32 - 6a+15}{12} (= 23)$ or $\frac{20a+32 - 6a+15}{12} (= 23)$

	eg $20a+32-6a-15=12 \times 23 (= 276)$ oe or $14a+17=276$			M1 fit for expanding brackets and multiplying both sides by denominator with no more than one error in total leading to a linear equation Accept a linear equation leading to $14a - 17 = 276$ oe or $14a + 47 = 276$ oe or $26a + 17 = 276$ This mark implies the previous M mark if not already awarded
	eg $20a-6a=276-32+15$ oe or $14a=259$			M1 fit dep on previous M1 for correctly rearranging terms in a on one side and number terms on the other side
	<i>Working required</i>	18.5		A1 oe dep on M2 eg $\frac{259}{14}$ or $\frac{37}{2}$

Q	Working	Answer	Mark	Notes
(b)	eg $\frac{3}{\sqrt{y}} \left(= \frac{3\sqrt{y}}{y} \right)$ or $\frac{3}{y^{0.5}}$ or $\frac{3}{y^{\frac{1}{2}}}$ or $\left(\frac{y^{0.5}}{3} \right)^{-1}$ or $\left(\frac{y^{\frac{1}{2}}}{3} \right)^{-1}$ oe		2	M1 for a correct first step by applying one of the following index rules $\sqrt{x} = x^{\frac{1}{2}} = x^{0.5}$ or $\left(\frac{a}{b} \right)^{-1} = \left(\frac{b}{a} \right)$
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$3y^{-0.5}$		A1 oe eg $3y^{-\frac{1}{2}}$, accept $c = 3$ and $n = -0.5$ oe
				Total 6 marks

Q13.

Q	Working	Answer	Mark	Notes
(a)	$5x(x+2) = 5x^2 + 10x$ or $(x+2)(3x-4) = 3x^2 - 4x + 6x - 8$ $(= 3x^2 + 2x - 8)$ or $5x(3x-4) = 15x^2 - 20x$		3	M1 for a correct intention to multiply all 3 factors by starting to multiply 2 factors only, allow one error
	eg $[(5x^2 + 10x)(3x - 4) =]$ $15x^3 - 20x^2 + 30x^2 - 40x$ or $[5x(3x^2 + 2x - 8) =]$ $15x^3 + 10x^2 - 40x$ or $[(x+2)(15x^2 - 20x) =]$ $15x^3 - 20x^2 + 30x^2 - 40x$			M1 (dep)ft for expanding by the third factor, allow one error (some may do the expansion in one stage and will get to $15x^3 - 20x^2 + 30x^2 - 40x$ without firstly expanding two factors, allow two errors)
		$15x^3 + 10x^2 - 40x$		A1 isw correct factorisation eg $5(3x^3 + 2x^2 - 8x)$ do not isw incorrect factorisation eg $15x^3 + 10x^2 - 40x = 3x^3 + 2x^2 - 8x$

Q	Working	Answer	Mark	Notes
(b)	$\left(\frac{2w^2}{y^5}\right)^{-3}$ or $\left(\frac{y^{20}}{16w^8}\right)^{\frac{3}{4}}$ or $\left(\frac{4096w^{24}}{y^{60}}\right)^{-\frac{1}{4}}$		3	M1 for one of fourth rooting or reciprocating or cubing
	$\left(\frac{8w^6}{y^{15}}\right)^{-1}$ or $\frac{2^{-3}w^{-6}}{y^{-15}}$ or $\frac{1}{8}w^{-6}$ or $\left(\frac{y^5}{2w^2}\right)^3$ or $\left(\frac{y^{60}}{4096w^{24}}\right)^{\frac{1}{4}}$ $\frac{0.125y^{15}}{w^6}$ or $\frac{0.125w^{-6}}{y^{-15}}$ or $\frac{0.125}{y^{-15}w^6}$ oe			M1 for two of fourth rooting or reciprocating or cubing
		$\frac{y^{15}}{8w^6}$		A1 allow $\frac{y^{15}}{8w^6}$ or $\frac{y^{15}w^{-6}}{8}$ or $0.125y^{15}w^{-6}$ or $\frac{1}{8}y^{15}w^{-6}$ or $\frac{w^{-6}}{8y^{-15}}$ or $\frac{1}{8y^{-15}w^6}$

Q	Working	Answer	Mark	Notes
	ALTERNATIVE		3	M2 for 2 correct terms (M1 for 1 correct term)
		$\frac{y^{15}}{8w^6}$		A1 allow $\frac{y^{15}}{8w^6}$ or $\frac{y^{15}w^{-6}}{8}$ or $0.125y^{15}w^{-6}$ or $\frac{1}{8}y^{15}w^{-6}$ or $\frac{w^{-6}}{8y^{-15}}$ or $\frac{1}{8y^{-15}w^6}$
				Total 6 marks

Q	Working	Answer	Mark	Notes
(a)		1	1	B1
(b)	eg $5y - 7y < 1 - 20$ or $-2y < -19$ oe or $20 - 1 < 7y - 5y$ or $19 < 2y$ oe or $y = 9.5$ or $y < 9.5$		2	M1 for correctly isolating terms in y on one side and number terms on the other side of an inequality or an equation. Ignore incorrect inequality signs for this mark
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$y > 9.5$		A1 oe eg $\frac{19}{2} < y$ Must have correct inequality symbol on answer line NB sight of correct answer in working space and just ($y =$) 9.5 on answer line gains M1 only
(c)		$5w^2x^2(3x^3 + 5w)$	2	B2 for the correct factorisation (B1 for a correct partial factorisation of at least 2 different terms outside the bracket eg $5wx(3wx^4 + 5w^2x)$

				or $5w^2(3x^5 + 5wx^2)$ or for the correct highest common factor on the outside and one term inside the bracket correct eg $5w^2x^2(3x^3 + \dots)$ or $5w^2x^2(\dots + 5w)$ or for $(3x^3 + 5w)$ as a factor)
(d)		$3a^3c^4$	2	B2 oe eg $\frac{3a^3}{c^{-4}}$ (B1 a single product with 2 of 3, a^3, c^4 correct eg $3a^3c^n$ where $n \neq 4$ or $3a^mc^4$ where $m \neq 3$ or pa^3c^4 where $p \neq 3$. One term can be missing with 2 correct for B1)
				Total 7 marks

Q15.

Q	Working	Answer	Mark	Notes
	$2^{-4x} = 2^5$ or $-4x = 5$ or $-\frac{4}{5}x = 1$ oe		2	M1
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$-\frac{5}{4}$		A1 oe allow eg $\frac{5}{-4}$
				Total 2 marks

Q16.

Question	Working	Answer	Mark	Notes
*	$7c - 8ct^2 = t^2 + 3$ oe		4	M1 for multiplying both sides by denominator and expanding the brackets
	$7c - 3 = t^2 + 8ct^2$ oe or $-8ct^2 - t^2 = 3 - 7c$ oe			M1 ft dep on 2 terms in t^2 and 2 other terms for collecting t^2 terms on one side and other terms on the other side
	$7c - 3 = t^2(1 + 8c)$ oe or $t^2(-8c - 1) = 3 - 7c$ oe			M1 ft dep on previous M1 for factorising for t^2
	<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	$t = (\pm) \sqrt{\frac{7c-3}{1+8c}}$		A1 oe eg $t = (\pm) \sqrt{\frac{3-7c}{-8c-1}}$ or $t = (\pm) \left(\frac{7c-3}{1+8c} \right)^{\frac{1}{2}}$ or $t = (\pm) \left(\frac{7c-3}{1+8c} \right)^{0.5}$ NB To award A1 we must see $t = (\pm) \sqrt{\frac{7c-3}{1+8c}}$ in working if $(\pm) \sqrt{\frac{7c-3}{1+8c}}$ alone is given as an answer
Total 4 marks				

Q17.

Q	Working	Answer	Mark	Notes
	eg $(2n + 1)^2 + (2n - 1)^2$ or $(2n + 1)^2 + (2n + 3)^2$ oe		3	M1 for setting up a correct algebraic expression (any letter can be used) must have intention to add (may come after expanding)
	Eg $4n^2 + 4n + 1 + 4n^2 - 4n + 1$ or $8n^2 + 2$ or $4n^2 + 4n + 1 + 4n^2 + 12n + 9$ or $8n^2 + 16n + 10$ oe			M1 correct expansion of brackets and correct signs or a correct result.
	eg $8 \times n^2 + 2$ $\frac{8n^2 + 16n + 10}{8} = n^2 + 2n + \frac{10}{8}$ which shows a remainder of 2 or $10 - 8 = 2$ or $\frac{8n^2 + 16n + 10}{8} = n^2 + 2n + 1$ remainder 2 oe $\frac{8n^2 + 16n + 10}{8} = n^2 + 2n + 1 + \frac{2}{8}$ oe $8(n^2 + 2n + 1) + 2$ oe	shown clearly		A1 conclusion dep on M2 for eg $8n^2 + 2$ and a suitable conclusion (may be shown as a calculation/in numbers). The conclusion must be an intention to show that the result is a multiple of 8 and there is 2 remaining.
Total 3 marks				

Q18.

Question	Working	Answer	Mark	Notes
	e.g. $n^2 - (n-1)^2$ or $(n+1)^2 - n^2$		3	M1 for setting up a correct algebraic expression (any letter can be used)
	e.g. $n^2 - n^2 + 2n - 1$ or $n^2 + 2n + 1 - n^2$			M1 Correct expansion of brackets and correct signs or a correct result
		e.g. $2n - 1$ is always odd		A1 dep on M2 for eg $2n - 1$ or $2n + 1$ or $-(2n + 1)$ oe and a suitable conclusion SCB1 for eg $(2n)^2 - (2n - 1)^2$ or $(2n + 1)^2 - (2n)^2$ oe
				<i>Total 3 marks</i>

Q19.

Question	Working	Answer	Mark	Notes
(a)	$T = k\sqrt{x}$		3	M1 or for $T = \sqrt{mx}$ k may be numeric (but not 1)
	$400 = k\sqrt{625}$ or $k = 16$ or $400 = \sqrt{m625}$ or $m = 256$			M1 implies the first M1
		$T = 16\sqrt{x}$		A1 accept $T = \sqrt{256x}$ Award 3 marks if $T = k\sqrt{x}$ but k is evaluated correctly in part (a) or (b). SC: B2 for correct formula for x in terms of T
(b)		120	1	B1 ft for a correct answer from a substitution into an equation (or expression) in the form $(T =) k\sqrt{x}$ except for $k = 1$
				<i>Total 4 marks</i>

Q20.

Question	Working	Answer	Mark	Notes
(a)	$P = \frac{k}{q^2}$	$P = \frac{51.2}{q^2}$	3	M1 Allow $Pq^2 = k$ or $q^2 = \frac{k}{p}$ Do not allow $P = \frac{1}{q^2}$
	$12.8 = \frac{k}{2^2}$ oe or $k = 12.8 \times 2^2$ or $k = 51.2$			M1 For correct substitution in a correct equation. Implies first M1 Award M2 if $k = 51.2$ stated unambiguously
				A1 Award 3 marks if answer is $P = \frac{k}{q^2}$ but k is evaluated in (a) or (b) SCB2 for $Pq^2 = 51.2$ or $q^2 = \frac{51.2}{p}$
(b)	$\frac{51.2}{8^2}$	0.8	1	B1ft ft equation in the form $P = \frac{k}{q^2}$ oe
Total 4 marks				

Q21.

Q	Working	Answer	Mark	Notes
(i)		142.75	1	B1
(ii)		142.85	1	B1 accept 142.8499... or 142.849
Total 2 marks				

Q22.

Q	Working	Answer	Mark	Notes
(a)		474.5	1	B1
(b)		125	1	B1 allow 124.9 or 124.999(9...)
Total 2 marks				

Q23.

Q	Working	Answer	Mark	Notes
(a)		2.745	1	B1
(b)		2.755	1	B1 allow 2.7549
(c)	$(80 \times 60) \div 2^2$		2	M1 For two of 80, 60, 2 or 4 rather than 2^2 oe
	eg $(80 \times 60) \div 2^2 = 1200$ oe <i>working with rounded values seen required</i>	1200		A1 dep on M1 for answer coming from the use of the 3 rounded numbers – if 1200 seen then ignore any other working and comments
				Total 4 marks

Q24.

Question	Working	Answer	Mark	Notes
		B	3	B1
		A		B1
		F		B1
				Total 3 marks

Q25.

Q	Working	Answer	Mark	Notes
(i)		$(-4, 7)$	1	B1
(ii)		$(5, 10)$	1	B1
				Total 2 marks

Q26.

Q	Working	Answer	Mark	Notes
	$8^2 + 15^2 (= 289)$	167	5	M1
	$\sqrt{8^2 + 15^2} (= 17)$			M1
	$\pi \times 8.5^2 (226.98\dots)$ or $0.5 \times 15 \times 8 (= 60)$			M1
	$\pi \times 8.5^2 - 0.5 \times 15 \times 8$ (“226.98” – “60”)			M1
				A1 Accept answers which round to 167
				Total 5 marks

Q27.

Question	Working	Answer	Mark	Notes
	$(AC^2 =) 17^2 - 15^2$		5	M1
	$(AC =) \sqrt{17^2 - 15^2} (= \sqrt{64} = 8)$			M1
	$\frac{\pi \times 8'}{2} (= 4\pi = 12.566\dots)$			M1 dep on M2 for $\frac{\pi \times 8'}{2}$ oe or 4π 12.5663...
	“12.566...” + 15 + 17			M1 for “12.566” + 15 + 17 and no additional values
		44.6		A1 for awrt 44.6
				Total 5 marks

Question	Working	Answer	Mark	Notes
Alternative mark scheme:				
	$\cos^{-1}\left(\frac{15}{17}\right) (= 28.0724)$ or $\sin^{-1}\left(\frac{15}{17}\right) (= 61.9275)$		5	M1 for a correct method to find one of the angles
	$15 \times \tan('28.0724') (= 8)$ or $15 \div \tan('61.9275') (= 8)$			M1
	$\frac{\pi \times 8'}{2} (= 4\pi = 12.566\dots)$			M1 dep on M2 for $\frac{\pi \times 8'}{2}$ or 12.5663... or 4π
	“12.566” + 15 + 17			M1 for “12.566” + 15 + 17 and no additional values
		44.6		A1 for awrt 44.6
				Total 5 marks

Q28.

Q	Working	Answer	Mark	Notes
	$8 \times 6 (=48)$ $0.5 \times 8 \times 6 (= 24)$ $15 \times 8 (= 120)$ $15 \times 6 (= 90)$ $15 \times 10 (= 150)$		3	M1 For a correct method to find the areas of 2 different faces (ie not 2 triangles) allow 8×6 as one area (allow if included with incorrect areas for this mark)
	$0.5 \times 8 \times 6 (= 24) (\times 2 (= 48))$ oe $15 \times 8 (= 120)$ $15 \times 6 (= 90)$ $15 \times 10 (= 150)$ (measurements with intention to add for the 2nd M mark) Surface area = " 120 " + " 90 " + " 150 " + " 24 " + " 24 " [allow " 120 " + " 90 " + " 150 " + " 48 " + " 48 "]			M1 for adding together 4 or 5 values for area, at least 3 of which are from a correct method NB: $(6 + 8 + 10) \times 15 (= 360)$ is 3 faces but only award this if clearly not intended to be the volume – eg by the addition of the area of a triangular end.
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	408		A1 cao SCB2 for an answer of 456 if no other marks awarded
Total 3 marks				

Q29.

Question	Working	Answer	Mark	Notes
(a)	$0.5 \times (11 + 7) \times 10$	90	2	M1 M1 for $(0.5 \times 2 \times 10) + (7 \times 10) + (0.5 \times 2 \times 10)$ A1
(b)	"90" $\times 12$	1080	2	M1 ft Their area in (a) $\times 12$ A1 ft
Total 4 marks				

Q30.

Q	Working	Answer	Mark	Notes
	$\pi \times 3^2 \times h = 72\pi$ oe		5	M1 Allow use of 3.14... or $\frac{22}{7}$ for π and use of 226... for 72π
	$h = 72\pi \div (\pi \times 3^2)$ oe or $h = 8$			M1 method to isolate h (may be seen in several stages)
	$2 \times \pi \times 3^2 (= 18\pi \text{ or } 56.54...)$ or $2 \times \pi \times 3 \times "8"$ oe ($= 48\pi$ or 150 - 151)			M1 method to find the area of the two circles or curved surface area – use of their h , dep on M1 (NB may get this mark for area of 2 circles with no previous marks awarded)
	$2 \times \pi \times 3^2 + 2 \times \pi \times 3 \times "8"$ oe ($= 66\pi$)			M1 complete method to find the total surface area ft their h dep on 1st M1, including intention to add, to find the total surface area
		207		A1 accept 207-208
				Total 5 marks

Q31.

Q	Working	Answer	Mark	Notes
	$\frac{4\pi r^2}{2} + \pi r^2 = \frac{16}{3}\pi$ or $3\pi r^2 = \frac{16}{3}\pi$			M1 allow $\frac{4\pi r^2}{2} + \pi r^2 = 16.755...$
	$r = \frac{4}{3}$ oe			A1 (allow 1.33... or better)
	$\frac{1}{2} \times \frac{4}{3} \pi \left(\frac{4}{3} \right)^3$			M1 dep on 1st M1 (need not include π) or answer of $\frac{128}{81}\pi (= 4.96(44...))$
		$\frac{128}{81}$	4	A1 $1\frac{47}{81}$ (accept 1.58(024...))
				Total 4 marks

Q32.

Question	Working	Answer	Mark	Notes
(a)(i)		{3, 5, 7}	2	B1
(a)(ii)		{1, 2, 3, 5, 7, 9}		B1
(b)		6	1	B1
				Total 3 marks

Q33.

Question	Working	Answer	Mark	Notes
(a)		10 6 14 15 12 20 14 29	3	B3 for all numbers in correct regions (B2 for 5, 6 or 7 correct numbers B1 for 3 or 4 correct numbers)
(b)		16	1	B1 ft for their $a +$ their b Do not ft if there are no values for a and b
(c)			2	M1 for $\frac{n}{43}$ where $n < 43$ or $\frac{18}{m}$ where $m > 18$ or ft their $\frac{b+c}{p}$ where $p > b + c$ or ft their $\frac{q}{a+b+c+d}$ where $q < a + b + c + d$ Do not ft if there are no values for a, b, c and d
		$\frac{18}{43}$		A1 oe eg 0.41(860...) or 41(.860...) % truncated or rounded or ft their $\frac{b+c}{a+b+c+d}$ as a fraction or a decimal or a percentage
Total 6 marks				

Q34.

Q	Working	Answer	Mark	Notes	
(a)		$30 < d \leq 40$	1	B1	Accept 30 – 40
(b)	$5 \times 5 + 15 \times 12 + 25 \times 17 + 35 \times 20 + 45 \times 6$ or $25 + 180 + 425 + 700 + 270$ or 1600		4	M2	$f \times d$ for at least 4 products with correct mid- interval values and intention to add. If not M2 then award M1 for d used consistently for at least 4 products within interval (including end points) and intention to add or for at least 4 correct products with correct mid-interval values with no intention to add
	$\frac{25+180+425+700+270}{5+12+17+20+6}$ or $\left(= \frac{1600}{60} \right)$			M1	dep on M1 (ft their products) NB: accept their 60 if addition of frequencies is shown
		26.7		A1	Accept 26.6 – 26.7 inclusive Accept 27 if M3 awarded Do not accept fractions or mixed numbers, e.g. $\frac{80}{3}$ or $26\frac{2}{3}$
					Total 5 marks

Q35.

Question	Working	Answer	Mark	Notes	
(a)	10×3 or 15×2 or $12 \times 7.5/3$			M1	or any correct fd in correct position and no errors, or 1 sq = 2 (runners) indicated.
		30	2	A1	
(b)	Missing blocks = 6cm, 10cm, 2cm		2	B2	3 correct blocks B1 1 or 2 correct blocks
(c)	$0.6 \times 20 + 0.8 \times "30"$ or $3 \times "4" + 8 \times "3"$ or 450×0.08			M1	(partitioning blocks) (time x fd's) {must see clear evidence that fd values used}.
		36	2	A1	cao
					Total 6 marks

Q36.

Q	Working	Answer	Mark	Notes	
	(frequency density =) $75 \div 100 (= 0.75)$ or any one correct value marked on the FD axis or uses their own linear FD scale to find the area of at least one of the third, fourth or fifth bars OR eg 1 (large) box / 1 (large) square = 12.5 books or or 5 (sml) squares = 2.5 books or 1 (sml) square / 1 box = 0.5 books		4	M1 for a correct calculation of frequency density or a correct value on the frequency density axis or use of their own linear frequency density scale to find the area of at least one of the third, fourth or fifth bars OR or a correct measure of scale Implied by a correct frequency for the third (250), fourth (125) or fifth (50) bar	M3 for any complete method that relies only on counting squares, eg counting large squares: $\frac{4+10+2}{6+18+20+10+4}$ Allow one error in number of squares in each of numerator and denominator but do not allow any omissions
	eg using frequency densities $75 + ("2.25" \times 100) + ("1" \times 250) + ("2.5" \times 50) + ("0.25" \times 200)$ (= $75 + 225 + 250 + 125 + 50 = 725$) OR eg using a measure of scale (eg large squares)			M1 for a method to work out the total number of books OR the total number of squares Allow one error in a frequency density value, class width value or number of squares but not an omission	Must use a consistent method for the award of more than one mark

	$(6 + 18 + 20 + 10 + 4) \times "12.5" (=725)$ oe OR eg total no. of large squares = $6 + 18 + 20 + 10 + 4 (=58)$ or total no. of sml squares = $150 + 450 + 500 + 250 + 100$ $(=1450)$			Allow ft their own linear frequency density scale	
	eg using frequency densities $("1" \times 50) + ("2.5" \times 50) + ("0.25" \times 100)$ $(= 50 + 125 + 25 = 200)$ OR eg using a measure of scale (eg large squares) $(4 + 10 + 2) \times "12.5"$ $(=200)$ oe OR eg no. of large squares = $4 + 10 + 2 (= 16)$ or no. of sml squares = $100 + 250 + 50 (= 400)$			M1 for a method to estimate the number of books between 400g and 600 g OR the total number of squares between 400 g and 600 g Allow one error in a frequency density value, class width value or number of squares but not an omission Allow ft their own linear frequency density scale	
	<i>Correct answer only scores full marks (unless from obviously incorrect working)</i>	$\frac{200}{725}$		A1 oe eg $\frac{8}{29}$ or any correct decimal or correct percentage rounded or truncated to 2sf. NB $\frac{200}{725} = 0.27(58\dots)$	
				Total 4 marks	

Q	Working	Answer	Mark	Notes	
	e.g. $8.8 \times 5 (=44)$			M1	for finding area of 50 – 55 bar
	e.g. $3.4 \times 10 (=34) + 7.2 \times 20 (=144) + 8.8 \times 5 (=44) + 4 \times 15 (=60) + 1.8 \times 10 (=18) (=300)$			M1	for method to find total area (condone two errors)
	$\frac{"44"}{"300"} \times 150$			M1	(dep on M2) for complete method
		22	4	A1	
					Total 4 marks

Q38.

Q	Working	Answer	Mark	Notes
(a)		27	1	B1 Allow 27 – 27.5
(b)	Readings are [18.5, 19.5] and [35, 36]		2	M1 for a correct method to allow 2 readings to be taken on the x -axis from CF 10 (or 10.25) and from CF 30 (or 30.75) oe
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	16		A1 Allow 15.5 – 17.5
(c)	$40 - 34 (= 6)$		2	M1
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	180		A1 cao
				Total 5 marks

Q39.

Question	Working	Answer	Mark	Notes
	$1 - (0.24 + 0.31) (= 0.45)$ Or $(0.24 + 0.31) \times 180 (= 99)$		4	M1 or for a correct equation for missing values eg $x + 0.24 + 2x + 0.31 = 1$ oe (can be implied by 2 probabilities that total 0.45 in table if not contradicted in working space)
	$'0.45' \div 3 (= 0.15)$ Or $'0.45' \times 180 (= 81)$ Or $180 - 99 (= 81)$			M1 (or 0.15 correctly placed in table as long as not contradicted)
	$'0.15' \times 180$ Or $'81' \div 3$			M1 or for an answer of $\frac{27}{180}$
		27		A1
				<i>Total 4 marks</i>

Q40.

Question	Working	Answer	Mark	Notes	
(a)		$\frac{12}{52}, \frac{40}{52}, \frac{11}{51}, \frac{40}{51}, \frac{12}{51}, \frac{39}{51}$	3	B3	B1 for each pair. Accept equivalent fractions Eg $\frac{12}{52} = \frac{3}{13}, \frac{40}{52} = \frac{10}{13}, \frac{12}{51} = \frac{4}{17}, \frac{39}{51} = \frac{13}{17}$ Accept equivalent decimals correct to at least 2dp (0.23, 0.77, 0.22, 0.78, 0.24, 0.76)
(b)	$\frac{12}{52} \times \frac{11}{51}$ or $\frac{132}{2652}$ or $\frac{11}{221}$ or 0.049(773...) or $\frac{40}{52} \times \frac{39}{51}$ or $\frac{1560}{2652}$ or $\frac{130}{221}$ or $\frac{10}{17}$ or 0.588(235...)		3	M1	fit their tree diagram M2 for $1 - \left(\frac{12}{52} \times \frac{40}{51} + \frac{40}{52} \times \frac{12}{51} \right)$ (= 1-0.361(99...))
	$\frac{12}{52} \times \frac{11}{51} + \frac{40}{52} \times \frac{39}{51}$ or $\frac{132}{2652} + \frac{1560}{2652}$ or $\frac{11}{221} + \frac{10}{17}$ oe			M1	
		$\frac{141}{221}$		A1	0.638(009...) rounded or truncated to at least 3 DP or oe
				Total 6 marks	

Question	Working	Answer	Mark	Notes	
	Alternative Method - With Replacement				
	$\frac{12}{52} \times \frac{12}{52}$ or $\frac{144}{2704}$ or $\frac{9}{169}$ or 0.053(254...) or $\frac{40}{52} \times \frac{40}{52}$ or $\frac{1600}{2704}$ or $\frac{100}{169}$ or 0.591(715...)			M1	M2 for $1 - \left(\frac{12}{52} \times \frac{40}{52} + \frac{40}{52} \times \frac{12}{52} \right)$ (=1-0.355(029...))

	$\frac{12}{52} \times \frac{12}{52} + \frac{40}{52} \times \frac{40}{52}$ or $\frac{144}{2704} + \frac{1600}{2704}$ or $\frac{9}{169} + \frac{100}{169}$ or $\frac{1744}{2704}$ or $\frac{109}{169}$ or 0.644(970....) oe			M1
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Q41.

Q	Working	Answer	Mark	Notes
	eg $(P(RRY) = \frac{9}{20} \times \frac{8}{19} \times \frac{7}{18} = \frac{504}{6840} = \frac{7}{95})$ oe or $(P(RRG) = \frac{9}{20} \times \frac{8}{19} \times \frac{4}{18} = \frac{288}{6840} = \frac{4}{95})$ oe or $(P(RRR) = \frac{9}{20} \times \frac{8}{19} \times \frac{7}{18} = \frac{504}{6840} = \frac{7}{95})$ oe or $(P(RRR') = \frac{9}{20} \times \frac{8}{19} \times \frac{11}{18} = \frac{792}{6840} = \frac{11}{95})$ oe or $(P(YYR) = \frac{7}{20} \times \frac{6}{19} \times \frac{9}{18} = \frac{378}{6840} = \frac{21}{380})$ oe or $(P(YYG) = \frac{7}{20} \times \frac{6}{19} \times \frac{4}{18} = \frac{168}{6840} = \frac{7}{285})$ oe or $(P(YYY) = \frac{7}{20} \times \frac{6}{19} \times \frac{5}{18} = \frac{210}{6840} = \frac{7}{228})$ oe or $(P(YYY') = \frac{7}{20} \times \frac{6}{19} \times \frac{13}{18} = \frac{546}{6840} = \frac{91}{1140})$ oe or $(P(GGR) = \frac{4}{20} \times \frac{3}{19} \times \frac{9}{18} = \frac{108}{6840} = \frac{3}{190})$ oe or $(P(GGY) = \frac{4}{20} \times \frac{3}{19} \times \frac{7}{18} = \frac{84}{6840} = \frac{7}{570})$ oe or $(P(GGG) = \frac{4}{20} \times \frac{3}{19} \times \frac{2}{18} = \frac{24}{6840} = \frac{1}{285})$ oe or $(P(GGG') = \frac{4}{20} \times \frac{3}{19} \times \frac{16}{18} = \frac{192}{6840} = \frac{8}{285})$ oe or $(P(RGY) = \frac{9}{20} \times \frac{7}{19} \times \frac{4}{18} = \frac{252}{6840} = \frac{7}{190})$ oe		3	M1 for finding one correct product, does not need to be labelled or for an answer of $\frac{17}{76}$ oe eg 0.22(3...) or 22(.3...)% or $\frac{65}{76}$ oe eg 0.85(5...) or 85(.5...)%

$(P(RRR' \text{ or } YYY' \text{ or } GGG') =)$ $\left(3 \times \frac{9}{20} \times \frac{8}{19} \times \frac{11}{18}\right) + \left(3 \times \frac{7}{20} \times \frac{6}{19} \times \frac{13}{18}\right) + \left(3 \times \frac{4}{20} \times \frac{3}{19} \times \frac{16}{18}\right)$ oe or $(P(RRY \text{ or } RRG \text{ or } YYR \text{ or } YYG \text{ or } GGR \text{ or } GGY) =)$ $\left(3 \times \frac{9}{20} \times \frac{8}{19} \times \frac{7}{18}\right) + \left(3 \times \frac{9}{20} \times \frac{8}{19} \times \frac{4}{18}\right) + \left(3 \times \frac{7}{20} \times \frac{6}{19} \times \frac{9}{18}\right) +$ $\left(3 \times \frac{7}{20} \times \frac{6}{19} \times \frac{4}{18}\right) + \left(3 \times \frac{4}{20} \times \frac{3}{19} \times \frac{9}{18}\right) + \left(3 \times \frac{4}{20} \times \frac{3}{19} \times \frac{7}{18}\right)$ oe or $(1 - P(RRR \text{ or } YYY \text{ or } GGG \text{ or } RGY) =)$ $1 - \left(\left(\frac{9}{20} \times \frac{8}{19} \times \frac{7}{18}\right) + \left(\frac{7}{20} \times \frac{6}{19} \times \frac{5}{18}\right) + \left(\frac{4}{20} \times \frac{3}{19} \times \frac{2}{18}\right) + \left(6 \times \frac{9}{20} \times \frac{7}{19} \times \frac{4}{18}\right)\right)$ oe			M1 for a complete calculation
Correct answer scores full marks (unless from obvious incorrect working) SCB1 for an answer of $\frac{669}{1000}$ oe eg 0.66(9) or 66(.9)%	$\frac{51}{76}$		A1 oe eg 0.67(1...) or 67(.1...)%
			Total 3 marks

Q42.

Q	Working	Answer	Mark	Notes
	$(RRR:) \frac{3}{12} \times \frac{2}{11} \times \frac{1}{10} (= \frac{1}{220})$ or $(0.25 \times 0.18... \times 0.1 = 0.0045...)$ $(2R, 1G:) \frac{3}{12} \times \frac{2}{11} \times \frac{9}{10} (= \frac{9}{220})$ or $(0.25 \times 0.18... \times 0.9 = 0.0409...)$ $(2G, 1R:) \frac{3}{12} \times \frac{9}{11} \times \frac{8}{10} (= \frac{36}{220} = \frac{9}{55})$ or $(0.25 \times 0.81... \times 0.8 = 0.163...)$ $(GGG:) \frac{9}{12} \times \frac{8}{11} \times \frac{7}{10} (= \frac{84}{220} = \frac{21}{55})$ $(0.25 \times 0.72... \times 0.7 = 0.381...)$		3	M1oe For an expression to find one of the stated probabilities
	$1 - \frac{1}{220}$ (1 - "0.0045...") or $\frac{84}{220} + 3 \times \frac{36}{220} + 3 \times \frac{9}{220}$ $(0.381... + 3 \times 0.163... + 3 \times 0.0409...)$			M1oe Dep M1 Complete method
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{219}{220}$		A1oe 0.9954....allow 0.99 (99%) or 0.995 (99.5%)
				Total 3 marks

Q43.

Question	Working		Answer	Mark	Notes
		RG and GR method	RR and GG method		
		$\frac{3}{t} \times \frac{t-3}{t-1}$ or $\frac{t-3}{t} \times \frac{3}{t-1}$	$\frac{3}{t} \times \frac{2}{t-1}$ or $\frac{t-3}{t} \times \frac{t-4}{t-1}$		M1 for one correct product
		$\frac{3}{t} \times \frac{t-3}{t-1} + \frac{t-3}{t} \times \frac{3}{t-1} = \frac{12}{35}$ or $2 \times \frac{3}{t} \times \frac{t-3}{t-1} = \frac{12}{35}$ oe	$\frac{3}{t} \times \frac{2}{t-1} + \frac{t-3}{t} \times \frac{t-4}{t-1} = \frac{23}{35}$		M1 dep on M1 for a correct equation
		e.g. $2t^2 - 37t + 105 (= 0)$ or allow $2t^2 - 37t = -105$			A1 (dep on M2) writing the correct quadratic expression in form $ax^2 + bx + c (= 0)$ allow $ax^2 + bx = c$
		e.g. $(2t - 7)(t - 15) = 0$ e.g. $t = \frac{-(-37) \pm \sqrt{(-37)^2 - 4 \times 2 \times 105}}{2 \times 2}$ e.g. $2 \left(\left(t - \frac{37}{4} \right)^2 - \left(\frac{37}{4} \right)^2 \right) = -105$			M1 (dep on A1) for a complete method to solve the 3-term quadratic equation (allow one sign error and some simplification - allow as far as $\frac{37 \pm \sqrt{1369 - 840}}{4}$) or Can be implied by answers of 15 (and $\frac{7}{2}$)
			12	5	A1 (dep on A1) cao
					Total 5 marks

Alt	RG and GR method	RR and GG method			
	$\frac{3}{x+3} \times \frac{x}{x+2} \text{ or } \frac{x}{x+3} \times \frac{3}{x+2}$	$\frac{3}{x+3} \times \frac{2}{x+2} \text{ or } \frac{x}{x+3} \times \frac{x-1}{x+2}$			M1 for one correct product
	$\frac{3}{x+3} \times \frac{x}{x+2} + \frac{x}{x+3} \times \frac{3}{x+2} = \frac{12}{35} \text{ or } 2 \times \frac{3}{x+3} \times \frac{x}{x+2} = \frac{12}{35} \text{ oe}$	$\frac{3}{x+3} \times \frac{2}{x+2} + \frac{x}{x+3} \times \frac{x-1}{x+2} = \frac{23}{35}$			M1 dep on M1 for a correct equation
	e.g. $2x^2 - 25x + 12 (= 0)$ or allow $2x^2 - 25x = -12$				A1 (dep on M2) writing the correct quadratic expression in form $ax^2 + bx + c (= 0)$ allow $ax^2 + bx = c$
	e.g. $(2x - 1)(x - 12) = 0$ e.g. $x = \frac{-(-25) \pm \sqrt{(-25)^2 - 4 \times 2 \times 12}}{2 \times 2}$ e.g. $2 \left(\left(x - \frac{25}{4} \right)^2 - \left(\frac{25}{4} \right)^2 \right) = -12$				M1 (dep on A1) for a complete method to solve the 3-term quadratic equation (allow one sign error and some simplification - allow as far as $\frac{25 \pm \sqrt{625 - 96}}{4}$) or can be implied by answers of 12 (and $\frac{1}{2}$)
			12	5	A1 (dep on A1) cao
					Total 5 marks