1	e.g. $35x + 10y = 27.5$ **or** $21x + 6y = 16.5$ $6x - 10y = 34$ $\quad$ $21x - 35y = 119$ $41x = 61.5$ $\quad$ $41y = -102.5$ e.g. $3x - 5\left(\frac{5.5-7x}{2}\right) = 17$ or $7\left(\frac{17+5y}{3}\right) + 2y = 5.5$ oe		4	M1	for a correct method to eliminate x or y: coefficients of x or y the same **and** correct operator to eliminate selected variable (condone any one arithmetic error in multiplication) **or** writing x or y in terms of the other variable and correctly substituting.
		$x = 1.5$ **or** $y = -2.5$		A1	oe, dep on M1
				M1	(dep on 1st M1) for a correct method to find other variable by substitution of found variable into one equation **or** for repeating the above method to find the second variable.
		$x = 1.5$ **and** $y = -2.5$		A1	oe, dep on M1
					Total 4 marks

2	**Elimination** E.g. $21x - 6y = 102$ $21x + 35y = -21$ $(-41y = 123)$ or $35x - 10y = 170$ $6x + 10y = -6$ $(41x = 164)$	**Substitution** E.g. $3\left(\frac{34+2y}{7}\right) + 5y = -3$ or $3x + 5\left(\frac{7x-34}{2}\right) = -3$ or $7\left(\frac{-3-5y}{3}\right) - 2y = 34$ or $7x - 2\left(\frac{-3-3x}{5}\right) = 34$		4	M1	for a correct method to eliminate x or y: coefficients of x or y the same **and** correct operation to eliminate selected variable (condone 1 arithmetical error) **or** for correctly writing x or y in terms of the other variable and correctly substituting
					A1	dep on M1 for $x = 4$ or $y = -3$
	E.g. $7x - 2 \times -3 = 34$				M1	dep on M1 for substitution of found variable **or** repeating the steps in first M1 for the second variable
			$x = 4$ $y = -3$		A1	cao A correct answer without working scores no marks
						Total 4 marks

3	$3y(2y+1) - y^2 = 8$ **or** $x = \frac{8+y^2}{3y} \rightarrow \frac{8+y^2}{3y} - 2y = 1$ **or** $\_\,3xy - y^2 = 8$ $3xy - 3y \times 2y = 3y \times 1$ oe	$3x\left(\frac{x-1}{2}\right) - \left(\frac{x-1}{2}\right)^2 = 8$ oe			M1	correct first step eg substitution by eg $x = 1 + 2y$ or $y = \frac{x-1}{2}$ to get an equation in a single variable **or** writing 2nd equation with x the subject and substituting into 1st **or** multiplying 2nd equation by $3y$ and subtracting from 1st oe
	eg $5y^2 + 3y - 8\ (= 0)$	eg $5x^2 - 4x - 33\ (= 0)$			A1	for a correct simplified quadratic
	$(5y + 8)(y - 1)\ (= 0)$ or $\frac{-3 \pm \sqrt{3^2 - 4\times5\times(-8)}}{2\times5}$	$(5x + 11)(x - 3)\ (= 0)$ or $\frac{4 \pm \sqrt{(-4)^2 - 4\times5\times(-33)}}{2\times5}$			M1ft	dep on M1 for solving their 3 term quadratic equation using any correct method (allow one sign error and some simplification – allow as far as $\frac{-3\pm\sqrt{9+160}}{10}$) or if factorising, allow brackets which expanded give 2 out of 3 terms correct)
	$y = -\frac{8}{5}$ and $y = 1$ (both)	$x = -\frac{11}{5}$ and $x = 3$ (both)			A1	dep on first M1
			$x = -\frac{11}{5}, y = -\frac{8}{5}$ $x = 3, y = 1$	5	A1	oe dep on first M1 Must be paired correctly
						Total 5 marks

4	(adding) $10x = -5$ or $21x + 35y = 42$ $21x - 15y = -33$ then $50y = 75$		3	M1	Correct method to eliminate x or y Or making coefficients of x or y the same **and** correct operator has been applied to eliminate x or y (2 out of 3 terms correct implies a correct operator) or correct algebraic substitution for x or y into other equation
		$x = -0.5$ oe $y = 1.5$ oe		A1 A1	Both A marks dep on M1
					Total 3 marks

5	gradient of $JK = -0.5$ **or** $m \times 2 = -1$			6	M1 for finding the gradient of JK using $m_1 \times m_2 = -1$
	$\frac{k-15}{6-j} = -\frac{1}{2}$ **or** $2k - j = 24$ **or** $j = 2k - 24$ **or** $k = \frac{j+24}{2}$ oe				M1 for expressing the gradient of JK in terms of j and k or a correct equivalent equation
	$(j-6)^2 + (k-15)^2 = 80$ oe **or** $\left(\frac{j+6}{2}, \frac{k+15}{2}\right)$ oe **or** $(j+4)^2 + 196 = 100 + (k-1)^2$ oe				M1 for finding equation of JK in terms of j and k **or** for finding the midpoint of M **or** for equating length HJ with length HK
	eg $3k^2 - 78k + 495 = 0$ oe **or** $5j^2 - 60j - 140 = 0$ oe **or** $5k^2 - 150k + 1045 = 0$ oe **or** $3j^2 - 12j - 36 = 0$ **oe** **or** gradient HM: eg $\frac{\frac{k+15}{2} - 1}{\frac{j+6}{2} + 4} = 2$ **or** $k = 2j + 15$ **or** $j = \frac{k-15}{2}$ oe				M1 (dep on M3) writing a correct quadratic expression in the form $ax^2 + bx + c\ (= 0)$ (allow $ax^2 + bx = c$) **or** A correct equation for the gradient of HM in terms of j and k or a correct equivalent equation
	eg $(k-15)(k-11)(=0)$ **or** $\frac{78 \pm \sqrt{(-78)^2 - 4\times3\times495}}{2\times3}$ **or** $(k-13)^2 - 169 + 165 (= 0)$	eg $(j-6)(j+2)(=0)$ **or** $\frac{12 \pm \sqrt{(-12)^2 - 4\times3\times-36}}{2\times3}$ **or** $(j-2)^2 - 4 - 12 (= 0)$			M1 (dep on M3) for a complete method to solve their 3-term quadratic equation (allow one sign error in the use of the quadratic formula) **or** a correct method to eliminate either j or k eg $2k - 24 = \frac{k-15}{2}$ oe **or** $\frac{j+24}{2} = 2j + 15$ oe
			$j = -2, k = 11$		A1
					Total 6 marks

5		$\left(\frac{j+6}{2}, \frac{k+15}{2}\right)$ oe			6	M1 for finding the midpoint of M
ALT		$\frac{\frac{k+15}{2}-1}{\frac{j+6}{2}+4} = 2$ **or** $k - 2j = 15$ **or** $k = 2j + 15$ **or** $j = \frac{k-15}{2}$ oe				M1 for expressing the gradient of JK in terms of j and k or a correct equivalent equation
		$(j-6)^2 + (k-15)^2 = 80$ oe **or** $(j+4)^2 + 196 = 100 + (k-1)^2$ oe				M1 for finding the length of JK in terms of j and k **or** for equating length HJ with length HK
		E.g. $5j^2 - 12j - 44 = 0$ **or** $3j^2 + 48j + 84 = 0$ oe	E.g. $5k^2 - 174k + 1309 = 0$ **or** $3k^2 + 6k - 429 = 0$ oe			M1 (dep on M3) writing the correct quadratic expression in form $ax^2 + bx + c\ (= 0)$ allow $ax^2 + bx = c$
		E.g. $(5j - 22)(j + 2)(=0)$ **or** $\frac{12 \pm \sqrt{(-12)^2 - 4\times5\times-44}}{2\times5}$ **or** $(j+8)^2 - 64 + 28 (=0)$	E.g. $(5k - 119)(k - 11)(=0)$ **or** $\frac{174 \pm \sqrt{(-174)^2 - 4\times5\times1309}}{2\times5}$ **or** $(k+1)^2 - 1 - 143 (=0)$			M1 (dep on M3) for a complete method to solve their 3-term quadratic equation (allow one sign error in the use of the quadratic formula)
			$j = -2,\ k = 11$			A1
						Total 6 marks

6	$x^2 + (x+2)^2 - 2(x+2) = 24$		5	M1	for substituting linear equation into the quadratic equation
	$2x^2 + 2x - 24\ (=0)$ or $x^2 + x - 12\ (=0)$ or $2x^2 + 2x = 24$ or $x^2 + x = 12$			A1	for a correct equation in the form $ax^2 + bx + c = 0$ or $ax^2 + bx = -c$
	$(x + 4)(x - 3)\ (= 0)$ or $x = \frac{-1 \pm \sqrt{1^2 - (4\times1\times-12)}}{2\times1}$ or $\left(x - \frac{1}{2}\right)^2 - \left(\frac{1}{2}\right)^2 - 12 = 0$			M1ft	dep on M1 for solving their quadratic equation using any correct method (allow one sign error and some simplification – allow as far as $\frac{-1 \pm \sqrt{1+48}}{2}$) or if factorising, allow brackets which expanded give 2 out of 3 terms correct)
	$x = -4$ and $x = 3$			A1	for both x values dep on M1
	$(-4, -2)$ and $(3, 5)$	$(-4, -2)$ and $(3, 5)$		A1	for both solutions dep on M1
Alternative mark scheme for 6					
	$(y-2)^2 + y^2 - 2y = 24$		5	M1	for substituting linear equation into the quadratic equation
	$2y^2 - 6y - 20\ (=0)$ or $y^2 - 3y - 10\ (=0)$ $2y^2 - 6y = 20$ or $y^2 - 3y = 10$			A1	for a correct equation in the form $ay^2 + by + c = 0$ or $ay^2 + by = -c$
	$(y - 5)(y + 2) = 0$ or $y = \frac{--3 \pm \sqrt{(-3)^2 - (4\times1\times-10)}}{2\times1}$ or $\left(y - \frac{3}{2}\right)^2 - \left(\frac{3}{2}\right)^2 - 10 = 0$			M1ft	dep on M1 for solving their quadratic equation using any correct method (allow one sign error and some simplification – allow as far as $\frac{3 \pm \sqrt{9+40}}{2}$) or if factorising, allow brackets which expanded give 2 out of 3 terms correct
	$y = 5$ and $y = -2$			A1	for both y values dep on M1
	$(-4, -2)$ and $(3, 5)$	$(-4, -2)$ and $(3, 5)$		A1	for both solutions dep on M1
					Total 5 marks

7		$[x =] \dfrac{5}{9\left(\dfrac{5}{5a-2}\right)+5}$ oe **or** $y = \dfrac{5}{9x} - \dfrac{5}{9}$ oe		4	M1	A correct substitution for y **or** writing y in terms of x
		$[x =] \dfrac{5(5a-2)}{45+5(5a-2)}$ oe **or** $(5-5x)(5a-2) = 45x$ oe **or** $9x = \dfrac{5(45a-18)}{35+25a}$ oe			M1	Multiplying each term in the numerator and denominator by $(5a - 2)$ to eliminate the fraction in the denominator **or** equating y's and getting rid of fractions as far as shown on left **or** single fraction in terms of a
		$[x =] \dfrac{25a-10}{35+25a}$ oe **or** $[x =] \dfrac{5(5a-2)}{5(7+5a)}$			M1	A correct fraction not in simplest form with all brackets expanded **or** numerator and denominator factorised with the same common factor taken out
		Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$x = \dfrac{5a-2}{7+5a}$		A1	Correctly simplified $x =$ needed for the answer, or $x =$ previously seen in working with correct simplified expression Do not isw if students have tried to do some incorrect cancelling eg $x = \dfrac{5a-2}{7+5a} = \dfrac{-2}{7}$ gets M3A0
						Total 4 marks

8	eg $10a + 4c = 20$ $+\ 2a - 4c = 7$ eg $\left[c = \dfrac{10-5a}{2}\right]$ oe $2a - 4\left(\dfrac{10-5a}{2}\right) = 7$ oe	eg $10a + 4c = 20$ $-\ 10a - 20c = 35$ eg $\left[a = \dfrac{7+4c}{2}\right]$ oe $5\left(\dfrac{7+4c}{2}\right) + 2c = 10$ oe		3	M1	multiplication of one or both equation(s) with correct operation selected (allow one arithmetic error) (if + or – is not shown then assume it is the operation that at least 2 of the 3 terms have been calculated for) **or** correct rearrangement of one equation with substitution into second
	eg 5 × "2.25" + $2c$ = 10 **or** 2 × "2.25" – $4c$ = 7	eg $5a$ + 2 × "–0.625" = 10 **or** $2a$ – 4 × "–0.625" = 7			M1	(dep on previous M1 but not on a correct first value) correct method to find second unknown – this could be a correct substitution into one of the equations given or calculated or starting again with the same style of working as for the first method mark
	Working required		$a = 2.25$ $c = -0.625$		A1	oe eg $a = \dfrac{9}{4}$, $c = -\dfrac{5}{8}$ for both solutions dependent on first M1
						Total 3 marks

9	$x^2+(3-2x)^2=18$	$\left(\frac{3-y}{2}\right)^2+y^2=18$		5	M1	substitution of linear equation into quadratic
	$5x^2-12x-9[=0]$ oe	$5y^2-6y-63[=0]$ oe			M1	simplified to a correct 3 term quadratic
	$(5x+3)(x-3)\ [=0]$ $\frac{-(-12)\pm\sqrt{(-12)^2-4\times5\times(-9)}}{2\times5}$ $5[(x-\frac{12}{10})^2-\frac{144}{100}]-9=0$ oe	$(5y-21)(y+3)\ [=0]$ $\frac{-(-6)\pm\sqrt{(-6)^2-4\times5\times(-63)}}{2\times5}$ $5[(y-\frac{6}{10})^2-\frac{36}{100}]-63=0$ oe			M1ft	dep on M1 for solving *their* 3 term quadratic equation using any correct method (if factorising, allow brackets which expanded give 2 out of 3 terms correct) (if using formula allow one sign error and some simplification – allow as far as $\frac{12\pm\sqrt{144+180}}{10}$ or $\frac{6\pm\sqrt{36+1260}}{10}$)(if completing the square allow as far as shown)
			$x=-0.6$ **and** $x=3$ **OR** $y=4.2$ **and** $y=-3$		A1	oe dep on M2 for both x-values **OR** both y-values
	Working must be shown		$x=-0.6$, $y=4.2$ $x=3$, $y=-3$		A1	oe dep on M2 (must be clearly shown as correct pairs), accept answers given as coordinates
						Total 5 marks

10	$y(6y+5)-2y^2=6$	$x\left(\frac{x-5}{6}\right)-2\left(\frac{x-5}{6}\right)^2=6$		5	M1	for substitution of linear equation into quadratic **or** multiplying linear equation by y e.g. $xy-6y^2=5y$ **and** intention to subtract the two equations
	E.g. $4y^2+5y-6\ (=0)$ oe $4y^2+5y=6$	E.g. $4x^2-10x-266\ (=0)$ oe $4x^2-10x=266$			A1	(dep on M1) writing the correct quadratic expression in form $ax^2+bx+c\ (=0)$ allow $ax^2+bx=c$
	E.g. $(4y-3)(y+2)\ (=0)$ $(y=)\ \frac{-5\pm\sqrt{5^2-4\times4\times-6}}{2\times4}$ $4\left[\left(y+\frac{5}{8}\right)^2-\left(\frac{5}{8}\right)^2\right]=6$ oe	E.g. $(2x-19)(x+7)\ (=0)$ $(x=)\ \frac{5\pm\sqrt{(-5)^2-4\times2\times(-133)}}{2\times2}$ $4\left[\left(x-\frac{10}{8}\right)^2-\left(\frac{10}{8}\right)^2\right]=266$ oe			M1	(dep on M1) for a complete method to solve their 3-term quadratic equation (allow one sign error and some simplification – allow as far as $\frac{-5\pm\sqrt{25+96}}{8}$ or $\frac{5\pm\sqrt{25+1064}}{4}$
	$(y=)\ \frac{3}{4}$ and $(y=)\ -2$	$(x=)\ \frac{19}{2}$ and $(x=)\ -7$			A1	Dep on first M1 for having two correct x values or two correct y values
			$x=\frac{19}{2},\ y=\frac{3}{4}$ $x=-7,\ y=-2$		A1	Dep on first M1 Must be paired and labelled correctly
						Total 5 marks

11	eg. $10x + 35y = 85$ $10x + 6y = -2$ with the operation of subtraction **or** $29y = 87$ **or** $6x + 21y = 51$ $35x + 21y = -7$ with the operation of subtraction **or** $29x = -58$ **or** eg $5\left(\frac{17-7y}{2}\right)+3y=-1$ **or** eg $5x+3\left(\frac{17-2x}{7}\right)=-1$		4	M1	for correct method to eliminate one variable – multiplying one or both equations so the coefficient of x or y is the same in both, with the correct operation to eliminate one variable (condone one arithmetic error) **or** isolating x or y in one equation and substituting into the other (condone one arithmetic error).
				M1	dep 1st M1 Substitute found value into one equation **or** correct method to eliminate second unknown.
		$x = -2$ $y = 3$		A1 A1	dep 1st M1
					Total 4 marks

12	$(1-2y)^2-9y-(1-2y)=2y^2-12$	$x^2-9\left(\frac{1-x}{2}\right)-x=2\left(\frac{1-x}{2}\right)^2-12$		5	M1 substitution of linear equation into quadratic
	e.g. $2y^2-11y+12(=0)$ oe allow $2y^2-11y=-12$ oe	e.g. $x^2+9x+14(=0)$ oe allow $x^2+9x=-14$ oe			A1 (dep on M1) writing the correct quadratic expression in the form $ax^2+bx+c\ (=0)$ allow $ax^2+bx=c$
	e.g. $(2y-3)(y-4)(=0)$ $(y=)\frac{11\pm\sqrt{(-11)^2-4\times2\times12}}{2\times2}$ e.g. $2\left[\left(y-\frac{11}{4}\right)^2-\left(\frac{11}{4}\right)^2\right]=-12$ oe	e.g. $(x+7)(x+2)(=0)$ $(x=)\frac{-9\pm\sqrt{9^2-4\times1\times14}}{2}$ e.g. $\left(x+\frac{9}{2}\right)^2-\left(\frac{9}{2}\right)^2=-14$			M1 (dep on M1) for a complete method to solve their 3-term quadratic equation (allow one sign error and some simplification – allow as far as $\frac{11\pm\sqrt{121-72}}{4}$ or $\frac{-9\pm\sqrt{81-56}}{2}$)
	$y=\frac{3}{2}$ oe and $y=4$	$x=-7$ and $x=-2$			A1 (dep on M1) both x-values **or** both y-values
			$x=-2$, $y=\frac{3}{2}$ oe and $x=-7$, $y=4$		A1 (dep on first M1) must be paired correctly
					Total 5 marks

13	**Elimination** eg $9x-15y=75$ $20x+15y=70$ + $(29x=145)$ or $12x-20y=100$ $12x+9y=42$ − $(-29y=58)$	**Substitution** eg $4\left(\frac{25+5y}{3}\right)+3y=14$ or $4x+3\left(\frac{25-3x}{-5}\right)=14$ or $3\left(\frac{14-3y}{4}\right)-5y=25$ or $3x-5\left(\frac{14-4x}{3}\right)=25$		4	M1	for a correct method to eliminate x or y: coefficients of x or y the same **and** correct operation to eliminate selected variable (condone 1 arithmetical error) **or** for correctly writing x or y in terms of the other variable and correctly substituting
					A1	dep on M1 for $x = 5$ **or** $y = -2$
	eg $3x - 5 \times$ "-2" $= 25$ **or** $4x + 3 \times$ "-2" $= 14$ **or** $3 \times$ "5" $- 5y = 25$ **or** $4 \times$ "5" $+ 3y = 14$				M1	dep on M1 for substitution of found variable **or** repeating the steps in first M1 for the second variable
			$x = 5$ $y = -2$		A1	cao, dep on M1 a correct answer without working scores no marks
						Total 4 marks

14	$(S_{10} =)\frac{10}{2}(2a+9d)$ **or** $(S_5 =)\frac{5}{2}(2a+4d)$ oe **or** $a+7d=45$		5	M1	for a correct expression for the sum of the first 10 terms (S_{10}) or the first 5 terms (S_5) **or** a correct equation for the 8th term Take 9 as their 10 – 1 and 4 as their 5 – 1 and 7 as their 8 – 1
	$\frac{10}{2}(2a+9d)=4\times\frac{5}{2}(2a+4d)$ oe			M1	for a correct equation relating S_{10} and S_5
	eg $d=2a$ oe **or** $a=\frac{d}{2}$ oe **or** $a + 7d = 45$ oe **and** eg $10a - 5d = 0$ oe **or** eg $\frac{10}{2}(2(45-7d)+9d)=4\times\frac{5}{2}(2(45-7d)+4d)$ oe **or** $5d = 10(45 - 7d)$ oe			M1	(dep on M1) for d in terms of a, or vice-versa (must be correct) **or** for $a + 7d = 45$ oe **and** correctly reducing the equation relating S_{10} and S_5 to an equation with one term in a and one term in d eg $10a - 5d = 0$ oe **or** substituting a correct expression into their correct equation to obtain an equation in just d
	eg $a+7(2a)=45$ **or** $d=6$ **or** eg $70a-35d=0$ $5a+35d=225$ + $(75a=225)$ or $10a-5d=0$ $10a+70d=450$ − $(-75d=-450)$			M1	(dep on M2) for a correct equation in just a **or** for $d = 6$ **or** for a correct method to eliminate a or d: coefficients of a or d the same **and** correct operation to eliminate selected variable (condone 1 arithmetical error)
		3		A1	Dep on M3
					Total 5 marks

15	$(3+2y)^2 - y^2 + 2(3+2y) = 10$	$x^2 - \left(\frac{x-3}{2}\right)^2 + 2x = 10$		5	M1	for using correct substitution of a linear equation into the quadratic – all terms shown correctly
	eg $3y^2 + 16y + 5(=0)$	eg $3x^2 + 14x - 49(=0)$ $3x^2 + 14x = 49$			A1	for a correct 3 term quadratic
	eg $(3y+1)(y+5)(=0)$ **or** $\frac{-16 \pm \sqrt{16^2 - 4\times3\times5}}{2\times3}$ **or** $3\left[\left(y+\frac{8}{3}\right)^2 - \left(\frac{8}{3}\right)^2\right] + 5 = 0$ (should give $(y=) -\frac{1}{3}, -5$)	eg $(3x-7)(x+7)(=0)$ **or** $\frac{-14 \pm \sqrt{14^2 - 4\times3\times(-49)}}{2\times3}$ **or** $3\left[\left(x+\frac{7}{3}\right)^2 - \left(\frac{7}{3}\right)^2\right] - 49 = 0$ (should give $(x=) \frac{7}{3}, -7$)			M1	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 $\frac{-16 \pm \sqrt{256-60}}{6}$ **or** $\frac{-14 \pm \sqrt{196+588}}{6}$ or if factorising allow brackets which expanded give 2 out of 3 terms correct) **or** correct values for x **or** correct values for y
	eg $x = 3 + 2 \times -5$ and $x = 3 + 2 \times -\frac{1}{3}$	eg $\frac{7}{3} - 2 \times y = 3$ $-7 - 2 \times y = 3$			M1ft	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)
			$x = \frac{7}{3}, y = -\frac{1}{3}$ $x = -7, y = -5$		A1	dep on M1 (allow coordinates) must be paired correctly allow $x = -7, y = -5$ $x = 2.33(3\ldots), y = -0.33(3\ldots)$
						Total 5 marks

16	eg $\begin{aligned}7x+3y&=3\\+\ 9x-3y&=21\end{aligned}$ or $\begin{aligned}21x+9y&=9\\-\ 21x-7y&=49\end{aligned}$ or eg $7x + 3(3x-7) = 3$ or $7\left(\frac{7+y}{3}\right) + 3y = 3$		3	M1	a correct method to eliminate x or y – multiplying one or both equations so that one variable can be eliminated (allow a total of one error in multiplication) **and** the correct operation to eliminate or for substitution of one variable into the other equation.
	If first M1 gained then they can substitute an incorrect value if from 'correct' method to gain this mark.			M1	dep on M1 for a correct method to calculate the value of other letter eg substitution or starting again with elimination
		$x = 1.5, y = -2.5$		A1	oe dep on M1
					Total 3 marks

17 $3y^2 + 7y + 16 = (2y-1)^2 - (2y-1)$	$3\left(\frac{x+1}{2}\right)^2 + 7\left(\frac{x+1}{2}\right) + 16 = x^2 - x$		5	M1 substitution of linear equation into quadratic.
E.g. $y^2 - 13y - 14 (= 0)$ oe $y^2 - 13y = 14$	E.g. $x^2 - 24x - 81 (= 0)$ oe $x^2 - 24x = 81$			A1 (dep on M1) writing the correct quadratic expression in form $ax^2 + bx + c (= 0)$ allow $ax^2 + bx = c$
E.g. $(y-14)(y+1)(=0)$ or $(y=)\frac{-(-13) \pm \sqrt{(-13)^2 - 4\times1\times-14}}{2}$ or $\left(y - \frac{13}{2}\right)^2 - \left(\frac{13}{2}\right)^2 = 14$ oe	E.g. $(x+3)(x-27)(=0)$ or $(x=)\frac{-(-24) \pm \sqrt{(-24)^2 - 4\times1\times-81}}{2}$ or $\left(x - \frac{24}{2}\right)^2 - \left(\frac{24}{2}\right)^2 = 81$ oe			M1 (dep on M1) for the first stage to solve their 3-term quadratic equation (allow one sign error and some simplification – allow as far as $\frac{13 \pm \sqrt{169+56}}{2}$ or $\frac{24 \pm \sqrt{576+324}}{2}$ or eg $\left(x - \frac{24}{2}\right)^2 - 225$ oe
$(x=)$ 2×'14'−1 and 2×'−1'−1	$(y=)\frac{'27'+1}{2}$ and $\frac{'-3'+1}{2}$ oe			M1 (dep on previous M1) may be implied by values of y or x that are consistent with a correct substitution.
		(27, 14) and (−3, −1)		A1 for both solutions dep on M2 Must be paired correctly. accept $x = 27, y = 14$ and $x = -3, y = -1$
				Total 5 marks

18	$3x^2+(2x-3)^2-x(2x-3)=5$	$3\left(\frac{y+3}{2}\right)^2+y^2-y\left(\frac{y+3}{2}\right)=5$		5	M1	Correct substitution of x for y (or y for x)
	$5x^2-9x+4(=0)$ oe **or** $5x^2-9x=-4$	$5y^2+12y+7(=0)$ oe **or** $5y^2+12y=-7$			M1	for a correct equation in the form $ax^2+bx+c\ (=0)$ oe **or** $ax^2+bx=-c$
	$(5x-4)(x-1)(=0)$ or $(x=)\frac{9\pm\sqrt{(-9)^2-4\times5\times4}}{2\times5}$ or $5\left[\left(x-\frac{9}{10}\right)^2-\left(\frac{9}{10}\right)^2\right]+4(=0)$ [leading to x values of 0.8 and 1]	$(5y+7)(y+1)(=0)$ or $(y=)\frac{-12\pm\sqrt{12^2-4\times5\times7}}{2\times5}$ or $5\left[\left(y+\frac{6}{5}\right)^2-\left(\frac{6}{5}\right)^2\right]+7(=0)$ [leading to y values of -1.4 and -1]			M1ft	dep on M1 for solving their quadratic equation using any correct method - if factorising, allow brackets which expanded give 2 out of 3 terms correct (if using formula or completing the square allow one sign error and some simplification – allow as far as $\frac{9\pm\sqrt{81-80}}{10}$ oe **or** $\frac{-12\pm\sqrt{144-140}}{10}$ oe **or** $5\left(x-\frac{9}{10}\right)^2-\frac{1}{20}$ oe **or** $5\left(y+\frac{6}{5}\right)^2-\frac{1}{5}$ oe
	$(y=)\ 2\times$ "0.8" -3 **and** $2\times$ "1" -3	$(x=)\frac{\text{"}-1.4\text{"}+3}{2}$ **and** $\frac{\text{"}-1\text{"}+3}{2}$			M1	dep on previous M1
			$x=0.8$ & $y=-1.4$ / $x=1$ & $y=-1$		A1	oe, for both solutions dep on M2
						Total 5 marks

19	eg $6x+10y=6.2$ $6x+3y=3.75$ $7y=2.45$ eg $30x+15y=18.75$ $9x+15y=9.3$ $21x\quad=9.45$ **or** eg $6\left(\frac{3.1-5y}{3}\right)+3y=3.75$		3	M1	for correct method to eliminate one variable – multiplying one or both equations so the coefficient of x or y is the same in both (condone one arithmetic error), with the intention to subtract all 3 terms to eliminate one variable (intention to subtract is clearly showing a minus sign or subtracting 2 or 3 out of 3 terms) **or** isolating x or y in one equation and substituting into the other
	eg. $6\times$ "0.45" $+3y=3.75$ or $3\times$ "0.45" $+5y=3.1$ **or** $3x+5\times$ "0.35" $=3.1$ or $6x+3\times$ "0.35" $=3.75$			M1	dep. Substitute found value into one equation **or** correct method to eliminate second unknown.
		$x=0.45$ oe $y=0.35$ oe		A1	dep M1
					Total 3 marks

20	$(Sm=)\frac{m}{2}(2a+(m-1)d)=39$ oe **or** $(S_2m=)\frac{2m}{2}(2a+(2m-1)d)=320$ oe		5	M1	one correct equation for S_m or S_{2m} (condone consistent use of n instead of m)
	$(Sm=)\frac{m}{2}(2a+(m-1)d)=39$ oe **and** $(S_2m=)\frac{2m}{2}(2a+(2m-1)d)=320$ oe			M1	both equations correct
	eliminate to get $dm^2=242$ oe			M1	
	$242=2\times11\times11$ or $242=2\times121$ oe			M1	
		$d=2$ $m=11$		A1	Dep on M2 Both correct
					Total 5 marks

21	eg $4x + 8y = 60$ or $3x + 6y = 45$ $-\ \underline{4x - 6y = 4}$ $+\ \underline{4x - 6y = 4}$ $(14y = 56)$ $(7x = 49)$ eg $4x - 6\left(\frac{15-x}{2}\right) = 4$ or $4(15-2y) - 6y = 4$ oe		3	M1	Correct method to eliminate x or y: coefficients of x or y the same **and** correct operator to eliminate selected variable (condone any one arithmetic error in multiplication) **or** correctly writing x or y in terms of the other variable and correctly substituting.
	eg $x + 2 \times 4 = 15$ or $7 + 2 \times y = 15$			M1	dep correct method to find second variable using their value from a correct method to find first variable or for repeating above method to find second variable.
	Working required	$x = 7, y = 4$		A1	dep on M1
					Total 3 marks

22	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

23	eg $5x + 4y = -2$ $+\ 8x - 4y = 17.6$ $(13x = 15.6)$ eg $[\,x = \frac{4.4+y}{2}\,]$ oe $5\left(\frac{4.4+y}{2}\right) + 4y = -2$ oe	eg $10x + 8y = -4$ $-\ 10x - 5y = 22$ $(13y = -26)$ eg $[\,y = 2x - 4.4\,]$ oe $5x + 4(2x - 4.4) = -2$ oe		3	M1	multiplication of one or both equation(s) with correct operation selected (allow one arithmetic error) (if + or − is not shown then assume it is the operation that at least 2 of the 3 terms have been calculated for) **or** correct rearrangement of one equation with substitution into second
	eg $5 \times$ “1.2” $+ 4y = -2$ **or** $2 \times$ “1.2” $- y = 4.4$	eg $5x + 2 \times$ “−2” $= 4.4$ **or** $2x -$ “−2” $= 4.4$			M1	(dep on previous M1 but not on a correct first value) correct method to find second unknown – this could be a correct substitution into one of the equations given or calculated or starting again with the same style of working as for the first method mark
	Working required		$x = 1.2$ $y = -2$		A1	oe eg $x = \frac{6}{5}$ for both solutions dependent on first M1
						Total 3 marks

24	$x^2+(7-2x)^2=34$	$\left(\frac{7-y}{2}\right)^2+y^2=34$		5	M1	substitution of linear equation into quadratic
	$5x^2-28x+15[=0]$ oe	$5y^2-14y-87[=0]$ oe			M1	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** and all are non-zero
	$(5x-3)(x-5)$ [= 0] or $\frac{-(-28)\pm\sqrt{(-28)^2-4\times5\times15}}{2\times5}$ or $5[(x-\frac{28}{10})^2-\frac{784}{100}]+15=0$ oe or $x=0.6$ **and** $x=5$ (allow incorrect labels for x/y)	$(5y-29)(y+3)$ [= 0] or $\frac{-(-14)\pm\sqrt{(-14)^2-4\times5\times(-87)}}{2\times5}$ or $5[(y-\frac{14}{10})^2-\frac{196}{100}]-87=0$ oe or $y=5.8$ **and** $y=-3$ (allow incorrect labels for x/y)			M1ft	dep on M1 for solving *their* 3 term quadratic equation using any correct method (if factorising, allow brackets which expanded give 2 out of 3 terms correct) (if using formula allow one sign error and some simplification – allow as far as $\frac{28\pm\sqrt{784-300}}{10}$ or $\frac{14\pm\sqrt{196+1740}}{10}$) (if completing the square allow as far as shown) or **correct values for x** or **correct values for y dep on correct quadratic**
	eg $y=7-2\times5$ and $y=7-2\times0.6$ (correct labels for x/y)	eg $5.8=7-2x$ and $-3=7-2x$ (correct labels for x/y)			M1ft	dep on previous M1 for substituting **their** 2 found values of x or y in a suitable equation **or** correct values for the other variable
	Working must be shown		$x=0.6$, $y=5.8$ $x=5$, $y=-3$		A1	dep on M1 and **the correct quadratic** (allow coordinates) must be paired correctly

25	Eg $(2x+1)^2+x(2x+1)=7$	eg $y^2+\left(\frac{y-1}{2}\right)y=7$		5	M1 for substitution of $y=\pm2x\pm1$ (or $x=\frac{\pm y\pm1}{2}$) into $y^2+xy=7$ to obtain an equation in x only (or y only)
	E.g. $6x^2+5x-6(=0)$ $6x^2+5x=6$	E.g. $3y^2-y-14(=0)$ $3y^2-y=14$			M1ft 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
	E.g. $(2x+3)(3x-2)(=0)$ or $x=\frac{-5\pm\sqrt{5^2-4\times6\times-6}}{2\times6}$ or $\left(x+\frac{5}{12}\right)^2-\left(\frac{5}{12}\right)^2=1$ $\left(x=-\frac{3}{2}\text{ and } x=\frac{2}{3}\right)$	E.g. $(y+2)(3y-7)(=0)$ or $y=\frac{-(-1)\pm\sqrt{(-1)^2-4\times3\times-14}}{2\times3}$ or $\left(y-\frac{1}{6}\right)^2-\left(\frac{1}{6}\right)^2=\frac{14}{3}$ $\left(y=-2\text{ and } y=\frac{7}{3}\right)$			M1ft dep on first M1 method to solve **their** 3 term quadratic using any correct method (allow one sign error and some simplification – allow as far as eg $\frac{-5\pm\sqrt{25+144}}{12}$ **or** $\frac{1\pm\sqrt{1+168}}{6}$ or if factorising allow brackets which expanded give 2 out of 3 terms correct) **or** correct values for x **or** correct values for y Accept (x =) 0.6(66..) rounded or truncated or (y =) 2.3(33…)
	$y=2\left(\text{"}-\frac{3}{2}\text{"}\right)+1(=-2)$ **and** $y=2\left(\text{"}\frac{2}{3}\text{"}\right)+1\left(=\frac{7}{3}\right)$	$-2=2x+1$ or $x=-\frac{3}{2}$ **and** $\frac{7}{3}=2x+1$ or $x=\frac{2}{3}$			M1ft dep on previous M1 for substituting **their** 2 found values of x or y into one of the two given equations **or** fully correct values for the other variable (correct labels for x / y)

		$\left(-\frac{3}{2},-2\right)$ $\left(\frac{2}{3},\frac{7}{3}\right)$		A1 oe dep on M2 allow $x=-1.5$, $y=-2$ $x=0.66(6\ldots)$, $y=2.33(3\ldots)$ truncated or rounded
	Working required			**Total 5 marks**

26	(gradient of AB =) "$-\frac{1}{2}$" or "2"$m = -1$		6	M1 for the use of $m_1 \times m_2 = -1$ or for "$-\frac{1}{2}$" embedded in a linear equation eg $y =$ "$-\frac{1}{2}$"$x + c$
	(gradient of AB =) $\frac{k-7}{6-j}$ oe **or** (midpoint of AB =)$\left(\frac{j+6}{2}, \frac{k+7}{2}\right)$ oe			M1 for a correct expression for the gradient which may be seen in an equation **or** for a correct expression for the midpoint which may be seen in an equation.
	$\frac{k-7}{6-j} = -\frac{1}{2}$ oe or $2k - j = 8$ oe **or** $\left(\frac{k+7}{2}\right) - 2\left(\frac{j+6}{2}\right) = 7$ oe or $k - 2j = 19$ oe			M1 for setting up a **correct** equation for AB in terms of gradient **or** for setting up a **correct** equation for the line given and the midpoint
	$\frac{k-7}{6-j} = -\frac{1}{2}$ oe or $2k - j = 8$ oe **and** $\left(\frac{k+7}{2}\right) - 2\left(\frac{j+6}{2}\right) = 7$ oe or $k - 2j = 19$ oe			A1 for 2 **correct** equations
	$k = -1$ **and** $j = -10$			A1 for a correct value of k **and** a correct value of j
	Working required	(−2, 3)		A1 dep on previous M1
				Total 6 marks

27	eg $21x + 9y = 24$ _ $2x + 9y = 14.5$ or $14x + 63y = 101.5$ _ $14x + 6y = 16$ **or** eg $7 \times \left(\frac{14.5 - 9y}{2}\right) + 3y = 8$		3	M1	for a correct method to eliminate x or y: multiplication of one or both equation(s) with correct operation selected (allow one arithmetic error) (if + or − is not shown then assume it is the operation that at least 2 of the 3 terms have been calculated for) **or** correct rearrangement of one equation with substitution into second
				M1	(dep on previous M1 but not on a correct first value) correct method to find second unknown – this could be a correct substitution into one of the equations given or calculated or starting again with the same style of working as for the first method mark
	Working required	$x = 0.5$ **and** $y = 1.5$		A1	oe, dep on M1
					Total 3 marks

28	$2(3y-1)^2+3y^2=11$	$2x^2+3\left(\frac{x+1}{3}\right)^2=11$		5	M1	substitution of linear equation into quadratic
	$21y^2-12y-9=0$ oe	$7x^2+2x-32=0$ oe			M1	dep on previous M1 for multiplying out and collecting terms, forming a three term quadratic in any form of $ax^2+bx+c\ (=0)$ with at least 2 coefficients (a or b or c) correct
	eg $(7y+3)(y-1)=0$ $\frac{-(-12)\pm\sqrt{(-12)^2-4\times21\times(-9)}}{2\times21}$ $21\left[(y-\frac{2}{7})^2-\frac{4}{49}\right]-9=0$ oe (gives $y=1,\ y=-\frac{3}{7}$)	eg $(7x+16)(x-2)=0$ $\frac{-(2)\pm\sqrt{(2)^2-4\times7\times-32}}{2\times7}$ $7\left[(x-\frac{1}{7})^2-\frac{1}{49}\right]-32=0$ (gives $x=2,\ x=-\frac{16}{7}$)			M1	dep on M1 for solving **their** 3 term quadratic equation using any correct method (if factorising, allow brackets which expanded give 2 out of 3 terms correct) (if using formula allow one sign error in subst terms and some simplification – allow as far as eg $\frac{12\pm\sqrt{144+756}}{42}$ or $\frac{-2\pm\sqrt{4+896}}{14}$)(if completing the square allow as far as shown (allow error in final constant) **or** correct values for x **or** correct values for y
	eg $3\times1-1$ **and** $3\times-\frac{3}{7}-1$	eg $\frac{2+1}{3}$ and $\frac{-\frac{16}{7}+1}{3}$			M1ft	dep on previous M1 for substituting (must be shown) **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		$x=2,\ y=1$ **and** $x=-\frac{16}{7},\ y=-\frac{3}{7}$		A1	dep on M2 (allow coordinates) must be paired correctly allow $x=-2.28(57\ldots)$ and $y=-0.42(85\ldots)$ (even if obtained from premature rounding of the other variable.)
						Total 5 marks