1. i. Solve the simultaneous equations

$$y = 2x^2 - 3x - 5,\ 10x + 2y + 11 = 0.$$

[5]

ii. What can you deduce from the answer to part (i) about the curve $y = 2x^2 - 3x - 5$ and the line $10x + 2y + 11 = 0$?

[1]

2. Solve the simultaneous equations

$$2x + y - 5 = 0, \qquad x^2 - y^2 = 3.$$

[5]

3. Solve the simultaneous equations

$$x^2 + y^2 = 34, \quad 3x - y + 4 = 0.$$

[5]

4. Solve the simultaneous equations.

$$x^2 + 8x + y^2 = 84$$
$$x - y = 10$$

[4]

5. Solve the simultaneous equations $y = 2x$ and $y = x^2 + 2x - 4$. [4]

6. Solve the simultaneous equations

$$y = x^2 - 6x, \qquad 2y + x - 6 = 0.$$ [5]

END OF QUESTION paper

Mark scheme

Question			Answer/Indicative content	Marks	Part marks and guidance	
1		i	$2x^2 - 3x - 5 = \dfrac{-10x - 11}{2}$	*M1	Substitute for x/y or attempt to get an equation in 1 variable only	or $10x + 2(2x^2 - 3x - 5) + 11 = 0$
		i	$4x^2 + 4x + 1 = 0$	A1	Obtain correct 3 term quadratic – could be a multiple e.g. $2x^2 + 2x + 0.5 = 0$	If x is eliminated, expect $k(8y^2 + 48y + 72) = 0$
		i	$(2x + 1)(2x + 1) = 0$	DM1	Correct method to solve resulting 3 term quadratic	
		i	$x = -\dfrac{1}{2}$	A1		**SC** If DM0 and $x = -\dfrac{1}{2}$ spotted
		i	$y = -3$	A1	<u>Examiner's Comments</u> Almost all candidates recognised the need to eliminate a variable and chose to eliminate y. There were errors in finding the quadratic, but most then went on to factorise correctly and find the values of both variables; forgetting to find y is now comparatively rare. A large number of candidates, however, found the substitution of $x = -\frac{1}{2}$ to find y difficult and many lost this mark.	**B1** for x value, **B1** for y value **B1** justifying only one root
		ii	Line is a tangent to the curve	B1√	**Must be consistent with their answers to their quadratic in (i).** **1 repeated root –** indicates one point. Accept tangent, meet at, intersect, touch etc. but do not accept cross **2 roots –** indicates meet at two points **0 roots –** indicates do not meet. Do not accept "do not cross" <u>Examiner's Comments</u> One acceptable response was that one root implied that the line was a tangent to the curve. The question did not specify that a geometrical comment was required and so "meeting at one point" was another acceptable response. Candidates who made an error in part (i) were rewarded for a consistent conclusion relating to their roots. Use of the word "cross" is unhelpful; for example, in the case where there are no	**Follow through from their solution to (i)**

					solutions saying "they do not cross" does not exclude the possibility that they touch. A number of candidates were using stock phrases irrespective of their answer to (i), such as "they are perpendicular" or "it just touches the x-axis" or stating the line was a tangent when they had found two different roots; these of course gained no credit.	
			Total	6		
2			$x^2 - (5 - 2x)^2 = 3$	M1*	Substitute for x/y or valid attempt to eliminate one of the variables	If y eliminated:
			$3x^2 - 20x + 28 = 0$	A1	Three term quadratic in solvable form	$3y^2 + 10y - 13 = 0$ $(3y + 13)(x - 1) = 0$
			$(3x - 14)(x - 2) = 0$	M1dep	Correct method to solve three term quadratic – **see appendix 1**	**Spotted solutions: If M*0**
			$x = \frac{14}{3}, x = 2$ $y = -\frac{13}{3}, y = 1$	A1	Both x values correct	**SC B1** $x = 2$, $y = 1$ **www** **SC B1** $x = \frac{14}{3}, y = -\frac{13}{3}$ **www**
				A1	Both y values correct. **Allow 1 A mark for one correct pair of x and y from correct factorisation.** **Examiner's Comments** The vast majority of candidates opted to substitute for y and so form a quadratic in x as the first step in solving this pair of simultaneous equations. Sign errors meant that not all candidates obtained the correct quadratic and even those who did found it difficult to factorise. Attempts to use the formula were also hampered by the relatively large number 28 and so many candidates got no further. Those who did succeed usually remembered to substitute to find y, but sign errors were again quite common in this part. Nonetheless, a significant proportion of candidates produced full, clear and accurate solutions.	Must show on both line and curve (Can then get 5/5 if both found **www** and exactly two solutions justified)
			Total	5		
3			$x^2 + (3x + 4)^2 = 34$	M1*	Substitute for x/y or valid attempt to eliminate one of the variables	If x eliminated:

			$10x^2 + 24x - 18 = 0$ $5x^2 + 12x - 9 = 0$	A1	Correct three term quadratic in solvable form	$10y^2 - 8y + 290 = 0$ $5y^2 - 4y + 145 = 0$
			$(5x - 3)(x + 3) = 0$	M1dep*	Attempt to solve resulting three term quadratic	$(5y - 29)(y + 5) = 0$
			$x = \frac{3}{5}, x = -3$	A1	Correct x values	Award **A1 A0** for one pair correctly found from correct quadratic **Spotted solutions:** If **M0 DM0** **SC B1** $x = \frac{3}{5}, y = \frac{29}{5}$ **www** **SC B1** $x = -3$, $y = -5$ **www** Must show on both line and curve (Can then get 5/5 if both found **www** and exactly two solutions justified) **Examiner's Comments** This familiar question was very well done with many candidates scoring full marks. The vast majority of candidates opted to substitute for y and so form a quadratic in x. There were some errors, for example 16 – 34 = 22, but most substitutions were very good and clearly shown. As in most recent sessions, candidates remain more likely to factorise, accurately, rather than depend on the quadratic formula. This usually resulted in the correct values of x, but a significant number of accuracy errors then occurred when substituting for y. Forgetting to work out the second variable was not entirely absent.
			$y = \frac{29}{5}, y = -5$	A1	Correct y values	
			Total	**5**		
4			$x2 + 8x + (x - 10)^2 = 84$ $2x^2 - 12x + 16 = 0$ $x = 2$, $x = 4$ $x = 2$ and $y = -8$ $x = 4$ and $y = -6$	M1(AO1.1a) A1(AO1.1b) A1(AO1.1) A1(AO1.1) [4]	Substitute the linear equation into the quadratic Correctly simplified answer BC, but allow by any valid **OR M1** $(y + 10)^2 + 8(y + 10) + y^2 = 84$ **A1** $2y^2$	

					method Values should be paired correctly	+ 28y + 96 = 0 A1 y = −8, y = −6
			Total	4		
5			$2x = x^2 + 2x - 4$ $x^2 - 4 = 0$ $x = 2$ or -2 $x = 2$ and $y = 4$ or $x = -2$ and $y = -4$	M1(AO1.1a) A1(AO1.1) A1(AO1.1) A1(AO1.1) [4]	or $x = 2$, $y = 4$ or $x = -2$, $y = -4$ Allow (2, 4) and (−2, −4)	Both x's or one pair x, y Must be paired
			Total	4		
6			$2(x^2 - 6x) + x - 6 = 0$ $2x^2 - 11x - 6 = 0$ $(2x+1)(x-6) = 0$ $x = -\frac{1}{2}, x = 6$ $y = \frac{13}{4}, y = 0$	M1* A1 M1*dep A1 A1 [5]	Substitute for x/y to eliminate one of the variables Correct 2/3-term quadratic in solvable form Attempt to solve resulting quadratic. **See appendix 1.** x values correct	If x eliminated: $y = (6 - 2y)^2 - 6(6 - 2y)$ $4y^2 - 13y = 0$ $y(4y - 13) = 0$ **Spotted solutions:** If **M0 DM0 SC B1** One correct pair **www** **SC B1** Second

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td><table><tr><td>y values correct

Award A1 A0 for one pair correctly found from correctly factorised quadratic</td><td>correct pair www Must show on both line and curve (Can then get 5/5 if both found www and exactly two solutions justified)</td></tr></table>
Examiner's Comments

Most candidates secured a large number of marks in this standard simultaneous equation question. Elimination of x tended to lead to more errors with the initial “y = ” being lost and resulting in an incorrect quadratic. Whichever variable was eliminated, difficulties with fraction arithmetic regularly led to loss of accuracy marks, particularly with the negative value of x. Around two-thirds.of candidates scored full marks.</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>5</td><td colspan="2"></td></tr>
</table>