1. (a) Solve $\frac{y}{4} = 5$

y = ...

(1)

(b) Factorise $x^2 + 4x$

....

(1)

(c) Simplify

(i) $m^2 \times m^5$

....

(ii) $t^7 \div t^3$

....

(2)

(d) Expand and simplify $(x + 5)(x + 3)$

....

(2)

(Total 6 marks)

2. (a) Solve $\frac{3}{x} + \frac{3}{2x} = 2$

x=....................................

(2)

(b) Using your answer to part (a), or otherwise,

solve $$\frac{3}{(y-1)^2} + \frac{3}{2(y-1)^2} = 2$$

y = ...

or y = ...

(3)

(Total 5 marks)

3. Solve the equation

$$\frac{x}{2x-3} + \frac{4}{x+1} = 1$$

x = ...

(Total 5 marks)

4. Solve the equation

$$\frac{3}{x+3} - \frac{4}{x-3} = \frac{5x}{x^2 - 9}$$

$x =$ ....

(Total 4 marks)

5. (a) Show that the equation

$$\frac{5}{x+2} = \frac{4-3x}{x-1}$$

can be rearranged to give $3x^2 + 7x - 13 = 0$

(3)

(b) Solve $3x^2 + 7x - 13 = 0$
Give your solutions correct to 2 decimal places.

x = ... or x = ...

(3)
(Total 6 marks)

6. Solve $\frac{5(2x+1)}{3} = 4x + 7$

$x =$ ....

(Total 3 marks)

1. (a) 20 — 1

B1 cao

(b) $x(x + 4)$ — 1

B1 cao

(c) (i) m^7 — 2

B1 cao

(ii) t^4

B1 cao

(d) $x^2 + 5x + 3x + 15 = x^2 + 8x + 15$ — 2

M1 for 3 of 4 terms $x^2 + 5x + 3x + 15$, signs not needed

A1 for $x^2 + 8x + 15$

[6]

2. (a) $\frac{3x}{x} + \frac{3x}{2x} = 2x$

$x = \frac{9}{4}$ 2

M1 for $\frac{6+3}{2x}$ *or* $\frac{3}{x} \times x + \frac{3}{2x} \times x = 2 \times x$ *or* $\frac{6x+3x}{2x^2} = 2$

A1 $\frac{9}{4}$ *oe*

(b) $(y-1)^2 = \frac{9}{4}$

$y - 1 = \pm\frac{3}{2}$

$y = \frac{5}{2}, -\frac{1}{2}$ 3

M1 $(y-1)^2 = "\frac{9}{4}"$ *or* $4y^2 - 8y - 5 = 0$ *oe*

A1 cao $\frac{5}{2}$ *oe*

A1 cao $-\frac{1}{2}$ *oe*

[5]

3. $x(x + 1) + 4(2x - 3) = (2x - 3)(x + 1)$
$x^2 + x + 8x - 12 = 2x^2 + 2x - 3x - 3$
$x^2 - 10x + 9 = 0$
$(x - 9)(x - 1) = 0$
$x = 1,9$ 5

M1 for multiplying through by common denominator $(2x - 3)(x + 1)$
M1 (dep) for either $x^2 + x + 8x - 12$ or $2x^2 + 2x - 3x - 3$ oe
A1 for correct quadratic (= 0)
M1 for a correct method to solve 3 term quadratic
A1 cao for both solutions

[5]

4. $3(x – 3) –4(x + 3) = 5x$
$3x – 9 – 4x – 12 = 5x$
$–x – 21 = 5x$
$6x = – 21$
$= –3.5$ 4

M1 for $\frac{3}{x+3} \times (x+3)(x-3) - \frac{4}{x-3} \times (x+3)(x-3)$

or $\frac{3(x-3)-4(x+4)}{(x+3)(x-3)}$ *or* $\frac{3}{x+3} \times \frac{x-3}{x-3} - \frac{4}{x+3} \times \frac{x+3}{x+3}$

or $\frac{5x}{x^2-9} \times (x+3)(x-3)$

M1 (dep) for 3(x – 3) – 4 (x + 3) or 5x
*M1 for 3x – 9 – 4x ± 12 = 5*x
A1 for –3.5

[4]

5. (a) $5(x – 1) = (4 – 3x)(x + 2)$
$5x – 5 = 4x + 8 – 3x^2 – 6x$ $(= 8 – 2x – 3x^2)$
$(3x^2 + 6x + 5x – 4x – 5 – 8 = 0)$
$3x^2 + 7x – 13 = 0$
Proof 3

M1 multiply through by (x – 1)(x + 2) and cancel correctly
M1 expand 5(x – 1) and (4 – 3x)(x + 2) correctly, need not be simplified
A1 rearrange to give required equation (dep on both Ms and fully correct algebra)

(b) $a = 3, b = 7, c = -13$

$$x = \frac{-7 \pm \sqrt{(7^2 + 4 \times 3 \times 13)}}{6} = \frac{-7 \pm \sqrt{(49 + 156)}}{6} = \frac{-7 \pm \sqrt{205}}{6}$$

$x = 1.2196\ldots$ or $-3.55297\ldots.$

Or

$$\left(x + \frac{7}{6}\right)^2 - \left(\frac{7}{6}\right)^2 - \frac{13}{3} = 0$$

$$\left(x + \frac{7}{6}\right) = \pm\sqrt{\left(\frac{7}{6}\right)^2 + \frac{13}{3}}$$

$x = 1.2196\ldots$ or $-3.55297\ldots.$

1.22

-3.55 3

M1 correct substitution in formula of a = 3, b = 7 and c = ±13

M1 reduction to $\frac{-7 \pm \sqrt{205}}{6}$

A1 1.215 to 1.22 and –3.55 to –3.555

Or

M1 $\left(x + \frac{7}{6}\right)^2$

M1 $-\frac{7}{6} \pm \sqrt{\frac{205}{36}}$

A1 1.215 to 1.22 and –3.55 to – 3.555

SC T&I 1 mark for 1 correct root, 3 marks for both correct roots

[6]

6. $\frac{10x + 5}{3} = 4x + 7$

$10x + 5 = 12x + 21$

$-16 = 2x$

-8 3

M1 for 10x + 5 or 12x + 21; either of these could be seen anywhere in the candidate's working

M1 (dep) for 10x – 12x = 21 – 5 oe or 5 – 21 = 12x – 10x oe

A1 cao

[3]

1. Three quarters of candidates answered part (a) correctly. It was disappointing that only 20% of candidates could factorise $x^2 + 4x$ correctly in part (b). Some tried to use two brackets. Many had no idea of what was required. In part (c), more than 60% of candidates answered (i) correctly. A common incorrect answer was m^{10}. Slightly fewer candidates were successful in (ii). It was pleasing that 40% of candidates managed to obtain three or four correct terms in part (b) but mistakes were often made in simplifying the expression. A common error in the expansion was a final term of 8 instead of 15. Common incorrect answers were $x^2 + 15$ and $2x + 8$.

2. Algebraic fractions continue to be a problem for most candidates. A common error was to add the numerators and denominators to get $\frac{6}{3x} = 2$. Other errors in the first step include $3 + 3 = 2 \times x \times 2x$ and $3x + 6x = 2$. A significant number of candidates who were able to do the first step were then unable to solve $\frac{9}{2x}=2$, or even $4x = 9$, to find the value of x. Many gave this as $x= \frac{4}{9}$. The majority of candidates missed the connection between part (a) and part (b) and attempted to solve the problem afresh. The first step for many was the expansion of the quadratic denominators. This resulted in some difficult algebra which rarely produced the correct answers. Of the minority who were able to find $4y^2 – 8y – 5= 0$, few could solve this for the values of y.

3. Multiplication through by $(2x – 3)(x + 1)$ seemed to be more successful than collecting the terms on the left hand side over a common denominator. Of those that multiplied through, many did it in two stages, first multiplying by $(x + 1)$ and then by $(2x – 3)$. Of course, the two approaches converge at the stage $x^2 + 9x – 12 = 2x^2 – x – 3$or its equivalent.

A significant number of candidates could not make the step from $\frac{x^2 + 9x - 12}{2x^2 - x - 3} = 1$ to a fully horizontal equation. Even from the fully horizontal stage there were some surprising errors – for example the equation was rewritten as $3x^2 +10x – 9 = 0$.

Further surprising problems came up when the equation had been partially simplified to, for example, $10x = x^2 + 9$ where many candidates went on to try to solve the equation by trial and improvement. They did not seem to recognise what they had as a quadratic equation.

Candidates who got as far as $x^2 –10x + 9 = 0$ generally went on to find the two solutions, although strangely some went even further and decided to discard one of the solutions. These candidates were not penalised.

4. Only the best candidates were able to make much progress with this question, but many were able to score a mark for realising $(x + 3)(x - 3) = x^2 - 9$. Some candidates gained a mark for expressing the LHS with a common denominator, e.g., $\frac{3(x-3)-4(x+3)}{(x+3)(x-3)}$, but a significant number of these went on to make an error in the subsequent simplification, e.g. $\frac{3x-9-4x+12}{(x+3)(x-3)}$ (common) or $\frac{3x-6-4x-12}{(x+3)(x-3)}$. A popular incorrect approach when dealing with the LHS was $\frac{3-4}{(x+3)(x-3)} = \frac{5x}{x^2-9}$, so $-1 = 5x$.

5. Responses to this question usually scored either full marks or zero marks. The usual correct methods seen were to multiply through directly by $(x - 1)(x + 2)$, cancel, expand and collect terms. The equivalent cross multiplication was also seen correctly carried out. A few candidates collected terms on the left hand side and then lost track of the signs or never got round to dealing with the denominator. An all too common error was to write $4 - 3x(x + 2)$ before expanding the brackets. Sometimes this was expanded correctly and other times as $4 - 3x^2 - 6x$.

Part (b) was a standard quadratic equation solution by formula. The most common errors included the detachment of the –7 term from the denominator to give the equivalent of $-b \pm \frac{\sqrt{b^2-4ac}}{2a}$ and the incorrect evaluation of the discriminant to give a value of -107 instead of the correct 205.

Some candidates got through to $\frac{-7 \pm \sqrt{205}}{6}$ but then misused their calculator and worked out the answers to $-7 \pm \frac{\sqrt{205}}{6}$.

A few enterprising students attempted the solution by completing the square. Even if carried through to a conclusion these candidates often lost marks through premature approximation.

6. The algebra involved in this question was beyond most candidates. Around 40% of responses gained 1 mark, generally for the correct expansion of $5(2x +1)$. Following this the vast majority of candidates were unable to get any further. Common errors included multiplying both sides by 3 to get $30x + 15 = 12x + 21$ or multiplying just part of the expression on the right hand side by 3 rather than the complete expression. Even if the candidate got to $10x + 5 = 12x + 21$, they could not manipulate this correctly to get the correct answer.