Question			Answer	Marks	Guidance
1			$\Rightarrow 5x(x+1) - 3(2x+1) = (2x+1)(x+1)$	M1*	Multiplying throughout by $(2x + 1)(x + 1)$ or combining fractions and multiplying up oe (eg can retain denominator throughout) Condone a single numerical error, sign error or slip provided that there is no conceptual error in the process involved Do not condone omission of brackets unless it is clear from subsequent work that they were assumed eg $5x(x + 1) - 3(2x + 1) = (2x + 1)(x \underline{- 1})$ gets M1 $5x(x + 1) - 3(2x + 1) = 1$ gets M0 $5x(x + 1)(2x + 1) - 3(2x + 1)(x + 1) = (x + 1)(2x + 1)$ gets M0 $5x(x + 1) - 3(2x + 1) = (2x + 1)$ gets M1, just, for slip in omission of $(x + 1)$
				M1dep*	Multiplying out, collecting like terms and forming quadratic (= 0). Follow through from their equation provided the algebra is not significantly eased and it is a quadratic. Condone a further sign or numerical error or a minor slip when rearranging
			$\Rightarrow \quad 3x^2 - 4x - 4 = 0$	A1	oe www (not fortuitously obtained – check for double errors)
			$\Rightarrow \quad (3x + 2)(x - 2) = 0$	M1	Solving their three term quadratic (= 0) provided $b^2 - 4ac \geq 0$. Use of correct quadratic equation formula (if formula is quoted correctly then only one sign slip is permitted, if the formula is quoted incorrectly M0, if not quoted at all substitution must be completely correct to earn the M1) or factorising (giving their x^2 term and one other term when factors multiplied out) or comp. the square (must get to the square root stage involving $\pm$ and arithmetical errors may be condoned provided their $3\left(x - 2/3\right)^2$ seen or implied)
			$\Rightarrow \quad x = -2/3$ or 2	A1	cao for both obtained www (condone – 0.667 or better) (If no factorisation (oe) seen B1 for each answer stated following correct quadratic)
				[5]	

Question			Answer	Marks	Guidance
2			$\frac{3x}{(2-x)(4+x^2)} = \frac{A}{2-x} + \frac{Bx+C}{4+x^2}$	M1	correct form of partial fractions (condone additional coeffs eg $\frac{Ax+B}{2-x} + \frac{Cx+D}{4+x^2}$ * or M1 **BUT** $\frac{A}{2-x} + \frac{B}{4+x^2}$ ** is M0)
			$\Rightarrow \quad 3x = A(4+x^2) + (Bx+C)(2-x)$	M1	Multiplying through oe and substituting values or equating coeffs at **LEAST AS FAR AS FINDING A VALUE** for one of their unknowns (even if incorrect) Can award in cases * and ** above Condone a sign error or single computational error for M1 but not a conceptual error Eg $3x = A(2-x) + (Bx+C)(4+x^2)$ is M0 $3x(2-x)(4+x^2) = A(4+x^2) + (Bx+C)(2-x)$ is M0 Do not condone missing brackets unless it is clear from subsequent work that they were implied. Eg $3x = A(4+x^2) + Bx + C(2-x) = 4A + Ax^2 + Bx + 2C - Cx$ is M0 $= 4A + Ax^2 + 2Bx - Bx^2 + 2C - Cx$ is M1
			$x = 2 \Rightarrow 6 = 8A$, $A = ¾$	A1	oe www [SC B1 $A = 3/4$ from cover up rule can be applied, then the M1 applies to the other coefficients] **NB** $\frac{A}{2-x} + \frac{B}{4+x^2} \Rightarrow A = 3/4$ is A0 ww (wrong working)
			x^2 coeffs: $0 = A - B \Rightarrow B = ¾$	A1	oe www
			constants: $0 = 4A + 2C \Rightarrow C = -1½$	A1	oe www [In the case of * above, all 4 constants are needed for the final A1] Ignore subsequent errors when recompiling the final solution provided that the coeffs were all correct
				[5]	

Question			Answer	Marks	Guidance
3			$\frac{4x}{x+1}-\frac{3}{2x+1}=1$		
			$\Rightarrow \quad 4x(2x+1)-3(x+1)=(x+1)(2x+1)$	M1	Multiplying throughout by $(2x + 1)(x + 1)$ or combining fractions and multiplying up oe (eg can retain denominator throughout) Condone a single numerical error, sign error or slip provided that there is no conceptual error in the process involved Do not condone omission of brackets unless it is clear from subsequent work that they were assumed eg $4x(2x + 1) - 3(x + 1) = (x + 1)(2x \underline{- 1})$ gets M1 $4x(2x + 1) - 3(x + 1) = 1$ gets M0 $4x(x + 1)(2x + 1) - 3(x + 1)(2x + 1) = (x + 1)(2x + 1)$ gets M0 $4x(2x + 1) - 3(x + 1) = (x + 1)$ gets M1, just, for slip in omission of $(2x + 1)$
			$\Rightarrow \quad 8x^2 + 4x - 3x - 3 = 2x^2 + 3x + 1$ $\Rightarrow \quad 6x^2 - 2x - 4 = 0$	DM1	Multiplying out, collecting like terms and forming quadratic = 0. Follow through from their equation provided the algebra is not significantly eased and it is a quadratic. Condone a further sign or numerical error or minor slip when rearranging.
			$\Rightarrow \quad 3x^2 - x - 2 = 0$	A1	or $6x^2 - 2x - 4 = 0$ oe www, (not fortuitously obtained - check for double errors)
			$\Rightarrow \quad (3x + 2)(x - 1) = 0$	M1	Solving their three term quadratic provided $b^2 - 4ac \geq 0$. Use of <u>correct</u> quadratic equation formula (can be an error when substituting into correct formula) or factorising (giving their correct x^2 and constant terms when factors multiplied out) or comp the square oe. soi
			$\Rightarrow \quad x = -2/3$ or 1	A1	cao for both obtained www (accept $-4/6$ oe, or exact decimal equivalent (condone -0.667or better))
				[5]	SC B1 $x = 1$ with or without any working

4 $\frac{1}{(2x+1)(x^2+1)} = \frac{A}{2x+1} + \frac{Bx+C}{x^2+1}$ $\Rightarrow$ $1 = A(x^2 + 1) + (Bx + C)(2x + 1)$ $x = -½ : 1 = 1¼ A \Rightarrow A = 4/5$ coeff of x^2: $0 = A + 2B \Rightarrow B = -2/5$ constants: $1 = A + C \Rightarrow C = 1/5$	M1 M1 B1 B1 B1 [5]	correct form of partial fractions mult up and equating or substituting oe soi www www www	for omission of *B* or *C* on numerator, M0, M1, then (x= -1/2, A= 4/5) B1, B0, B0 is possible. for $\frac{A+Dx}{2x+1} + \frac{Bx+C}{x^2+1}$, M1,M1 then B1 for both A=4/5 and D=0, B1, B1 is possible. isw for incorrect assembly of final partial fractions following correct *A*,*B* & *C*. condone omission of brackets for second M1 only if the brackets are implied by subsequent working.

5	$\frac{x}{x^2-1}+\frac{2}{x+1}=\frac{x}{(x-1)(x+1)}+\frac{2}{x+1}$	B1	$x^2-1=(x+1)(x-1)$
	$=\frac{x+2(x-1)}{(x-1)(x+1)}$	M1	correct method for addition of fractions
	$=\frac{(3x-2)}{(x+1)(x-1)}$	A1	or $\frac{(3x-2)}{x^2-1}$ do not isw for incorrect subsequent cancelling
or	$\frac{x}{x^2-1}+\frac{2}{x+1}=\frac{x(x+1)+2(x^2-1)}{(x^2-1)(x+1)}$	M1	correct method for addition of fractions
	$=\frac{3x^2+x-2}{(x^2-1)(x+1)}$		$(3x-2)(x+1)$
	$=\frac{(3x-2)(x+1)}{(x^2-1)(x+1)}$	B1	accept denominator as x^2-1 or $(x-1)(x+1)$ do not isw for incorrect subsequent cancelling
	$=\frac{(3x-2)}{(x^2-1)}$	A1 [3]	

6 $\sqrt{4+x} = 2(1+\frac{x}{4})^{\frac{1}{2}}$	M1	dealing with √4 (or terms in $4^{\frac{1}{2}}$, $4^{\frac{-1}{2}}$,…etc)
$= 2(1+\frac{1}{2}.\frac{x}{4}+\frac{\frac{1}{2}.-\frac{1}{2}}{2}(\frac{x}{4})^2+...)$	M1 A1	correct binomial coefficients correct **unsimplified** expression for $(1+x/4)^{\frac{1}{2}}$ or $(4+x)^{\frac{1}{2}}$
$= 2(1+\frac{1}{8}x-\frac{1}{128}x^2+...)$		
$= 2+\frac{1}{4}x-\frac{1}{64}x^2+...$	A1	cao
Valid for $-1 < x/4 < 1$ $\Rightarrow$ $-4 < x < 4$	B1 [5]	

7(i) $\frac{3}{(y-2)(y+1)} = \frac{A}{y-2}+\frac{B}{y+1}$ $= \frac{A(y+1)+B(y-2)}{(y-2)(y+1)}$		
$\Rightarrow$ $3 = A(y+1) + B(y-2)$ $y = 2 \Rightarrow 3 = 3A \Rightarrow A = 1$ $y = -1 \Rightarrow 3 = -3B \Rightarrow B = -1$	M1 A1 A1 [3]	substituting, equating coeffs or cover up
(ii) $\frac{dy}{dx} = x^2(y-2)(y+1)$		
$\Rightarrow$ $\int \frac{3\,dy}{(y-2)(y+1)} = \int 3x^2\,dx$	M1	separating variables
$\Rightarrow$ $\int (\frac{1}{(y-2)}-\frac{1}{y+1})\,dy = \int 3x^2\,dx$		
$\Rightarrow$ $\ln(y-2) - \ln(y+1) = x^3 + c$	B1ft B1	$\ln(y-2) - \ln(y+1)$ ft their A,B $x^3 + c$
$\Rightarrow$ $\ln\left(\frac{y-2}{y+1}\right) = x^3 + c$		
$\Rightarrow$ $\frac{y-2}{y+1} = e^{x^3+c} = e^{x^3}.e^c = Ae^{x^3}$ *	M1 E1 [5]	anti-logging including c www

8 $\frac{2x}{x^2-4}+\frac{x}{x+2}=\frac{\quad +2}{(x-2)(x+2)}\ x$ $=\frac{x\ 2(x+2 \quad 2)}{(x+2)(x-2)}$ $=\frac{3x-4}{(x+2)(x-2)}$	M1 M1 A1 [3]	combining fractions correctly factorising and cancelling (may be $3x^2+2x-8$)

9(i) $(1+4x^2)^{-\frac{1}{2}} = 1 - \frac{1}{2}.4x^2 + \frac{(-\frac{1}{2}).(-\frac{3}{2})}{2!}(4x^2)^2 + \ldots$ $= 1-2x^2+6x^4 + \ldots$ Valid for $-1 < 4x^2 < 1 \Rightarrow -\frac{1}{2} < x < \frac{1}{2}$	M1 A1 A1 M1A1 [5]	binomial expansion with $p = -1/2$ $1 - 2x^2 \ldots$ $+ 6x^4$
(ii) $\frac{1-x^2}{\sqrt{1+4x^2}} = (1-x^2)(1-2x^2+6x^4+\ldots)$ $= 1 - 2x^2 + 6x^4 - x^2 + 2x^4 + \ldots$ $= 1 - 3x^2 + 8x^4 + \ldots$	M1 A1 A1 [3]	substitititing their $1-2x^2+6x^4+\ldots$ and expanding ft their expansion (of three terms) cao

10 (i) $A \approx 0.5[\frac{1.1696+1.0655}{2}+1.1060]$ $= 1.11$ (3 s f.)	M1 A1 cao [2]	Correct expression for trapezium rule
(ii) $(1+e^{-x})^{1/2} = 1+\frac{1}{2}e^{-x}+\frac{\frac{1}{2}.-\frac{1}{2}}{2!}(e^{-x})^2+\ldots$ $\approx 1+\frac{1}{2}e^{-x}-\frac{1}{8}e^{-2x}$ *	M1 A1 E1 [3]	Binomial expansion with $p = \frac{1}{2}$ Correct coeffs
(iii) $I = \int_1^2 (1+\frac{1}{2}e^{-x}-\frac{1}{8}e^{-2x})dx$ $= \left[x-\frac{1}{2}e^{-x}+\frac{1}{16}e^{-2x}\right]_1^2$ $= (2-\frac{1}{2}e^{-2}+\frac{1}{16}e^{-4})-(1-\frac{1}{2}e^{-1}+\frac{1}{16}e^{-2})$ $= 1.9335 - 0.8245$ $= 1.11$ (3 s.f.)	M1 A1 A1 [3]	integration substituting limits into correct expression