Question			Answer	Marks	AO	Guidance	
12	**(a)**		du = e^{x}dx	**B1**	**1.1**	Correct statement linking du and dx	or $\mathrm{d}x = \frac{1}{u+2}\mathrm{d}u$
			$\int \frac{7(u+2)-8}{u^2} \cdot \frac{1}{u+2}\,\mathrm{d}u$	**M1**	**1.1**	Use e^x = u + 2 to attempt integrand in terms of u	Must see clear evidence of substitution, including how e^{x}dx is dealt with **M0** for going straight from 7e^x – 8 to 7u + 6 with no justification Must include du
			$= \int \frac{7u+14-8}{u^2(u+2)}\,\mathrm{d}u = \int \frac{7u+6}{u^2(u+2)}\,\mathrm{d}u$	**A1**	**2.1**	Correct integrand	Including both integral sign and du throughout, as **AG**
				[3]			

Question			Answer	Marks	AO	Guidance	
12	(b)		$\frac{A}{u}+\frac{B}{u^2}+\frac{C}{u+2}=\frac{7u+6}{u^2(u+2)}$ $Au(u+2)+B(u+2)+Cu^2=7u+6$	M1	3.1a	Attempt correct partial fractions May have $\frac{Au+B}{u^2}+\frac{C}{u+2}$ but **M0** for just $\frac{B}{u^2}$ with no $\frac{A}{u}$	Correct method to combine correct fractions, and at least one constant attempted If considering $\frac{7}{u^2}+\frac{-8}{u^2(u+2)}$ then must use partial fractions on the second term to get credit
			$\frac{2}{u}+\frac{3}{u^2}-\frac{2}{u+2}$	A1	2.1	Correct partial fractions May have $\frac{2u+3}{u^2}-\frac{2}{u+2}$	Possibly implied by their *A*, *B*, and *C* values ie $A = 2$, $B = 3$, $C = -2$
			$2\ln\lvert u\rvert - 2\ln\lvert u+2\rvert - 3u^{-1}$	M1	1.1	Attempt integration of $\frac{B}{u^2}$ and at least one of $\frac{A}{u}$ or $\frac{C}{u+2}$, and no others	Allow errors in coefficients only Allow **M1** if only two fractions, as long as of required form If using $\frac{Au+B}{u^2}$ then it must be a correct integration attempt (ie split into two fractions first)
				A1FT	2.1	FT on their two or three fractions as long as ku^{-2} and one or two fractions each with a linear denominator	Condone brackets not modulus Condone no brackets as long as implied by later working, eg when limits are used
			$(2\ln4 - 2\ln6 - \frac{3}{4}) - (2\ln2 - 2\ln4 - \frac{3}{2})$	M1	1.1a	Attempt use of correct limits – correct order and subtraction; *u* or *x* but commensurate with their integral	Allow substitution into any function that is clearly attempt at integration

Question			Answer	Marks	AO	Guidance	
			$\left(\frac{3}{2}-\frac{3}{4}\right)+\ln\left(\frac{4\times4}{6\times2}\right)^2$	**M1**	**3.1a**	Attempt to rearrange correct numerical integral to required form	Must be correct numerical expression from correct working Terms may have been combined before use of limits, but must still be correct expression to gain **M1** Correct attempt to combine ln terms ie deal with coefficients and correct product / quotient for the sum / differences Allow one slip
			$\frac{3}{4}+\ln\frac{16}{9}$	**A1**	**2.1**	Obtain $\frac{3}{4}+\ln\frac{16}{9}$	Condone $\frac{3}{4}+2\ln\frac{4}{3}$ Fractions must be simplified ISW an incorrect attempt to write this answer in a different form, but **A0** if further work done eg multiplying by a constant to clear the fractions
				[7]			