8	**(a)**		Summary scheme			
			Attempt separate variables using $(100 - P)$	**M1**	**3.1a**	
			Correct integral, but allowing			
			$\lvert 100 - P\rvert$ or $(P - 100)$ or $(100 - P)$	**A1**	**1.1**	Allow without + c
			Attempt $t = 0$, $P = 2000$ to find c or A or $e^{\pm c}$	**M1**	**3.4**	dep M1
			$c = -\ln 1900$ or $A = 1900$ or $e^{\pm c} = 1900$			
			OR Allow $c = \ln 1900$ or $-\ln(-1900)$			
			or A or $e^{\pm c} = -1900$ or $-\frac{1}{1900}$	**A1**	**3.4**	dep M1M1
			Attempt make P the subject	**M1**	**3.4**	dep M1M1A1
			Correct use of mod & change to $P - 100$	**M1**	**2.1**	
			$P = 1900e^{-t} + 100$	**A1**	**1.1**	dep M1A1M1A1M1M1 ie dep all correct working seen
			Examples of correct methods			
			$\frac{dP}{100-P} = dt$	**M1**		
			$-\ln\lvert 100 - P\rvert = t + c$ or $\lvert 100 - P\rvert = Ae^{-t}$	**A1**		
			Substitute $t = 0$, $P = 2000$	**M1**		
			$\Rightarrow c = -\ln 1900$ or $A = 1900$	**A1**		
			$\ln\frac{\lvert 100-P\rvert}{1900} = -t$ or $\lvert 100 - P\rvert = 1900e^{-t}$			
			$\frac{P-100}{1900} = e^{-t}$			
				M1		
			$P = 1900e^{-t} + 100$	**A1**		
				A1		

Question			Answer	Mark	AO	Guidance
8	(a)	ctd	$\frac{dP}{P-100} = -dt$	M1		
			$\ln(P-100) = -t + c$ or $P - 100 = Ae^{-t}$	M1 A1		
			Substitute $t = 0$, $P = 2000$	M1		
			$\Rightarrow c = \ln 1900$ correct or $A = 1900$	A1		
			$\ln(P-100) = -t + \ln 1900$ or $P - 100 = 1900e^{-t}$			
			$\frac{P-100}{1900} = e^{-t}$			
			$P = 1900e^{-t} + 100$	M1 A1		
			Example of incorrect methods			(
			$\frac{dP}{100-P} = dt$	M1		
			$-\ln(100-P) = t + c$ or $100 - P = Ae^{-t}$	A1		
			$100 - P = e^{-t-c}$			
			Substitute $t = 0$, $P = 2000$	M1		
			$\Rightarrow e^{-c} = -1900$ or $A = -1900$	A1		
			$100 - P = -1900e^{-t}$ oe			
			No change to $P - 100$	M0		
			$P = 1900e^{-t} + 100$	M1 A0		Correct answer but incorrectly obtained, not using modulus
			$\frac{dP}{100-P} = dt$	M1		
			$\ln(100-P) = t + c$	A0		
			Substitute $t = 0$, $P = 2000$	M1		
			$\ln(-1900) = c$	A1		
			$\ln(100-P) = t + \ln(-1900)$			
			$100 - P = -1900e^{t}$			
			No change to $P - 100$	M0		
			$P = 100 + 1900e^{t}$	M1 A0		

Question			Answer	Mark	AO	Guidance
8	**(b)**		(Starts at 2000) Decreases Approaches 100	**B1f** **B1f** **[2]**	**3.4** **3.4**	B1 for correct process or ft (a) dep (a) includes exponential B1 for correct limit or ft (a) dep (a) includes exponential