Q	Marking instructions	AO	Marks	Typical solution
10(a)	Takes natural logs of both sides to obtain $\ln N = \ln (A \times B^t)$ or $\ln \frac{N}{A} = \ln B^t$	3.4	B1	$\ln N = \ln (A \times B^t)$ $\ln N = \ln A + \ln B^t$ $\ln N = \ln A + t \ln B$
	Uses a log rule correctly for example $\ln \frac{N}{A} = \ln N - \ln A$ $\ln (A \times B^t) = \ln A + \ln B^t$ $\ln B^t = t \ln B$	1.1a	M1	
	Completes reasoned argument to show the linear relationship For example, obtains $\ln N = \ln A + t \ln B$ with no errors Typical solution with first line omitted scores B0M1R1 Typical solution with second line omitted scores B1M1R0	2.1	R1	
	Subtotal		**3**	

Q	Marking instructions	AO	Marks	Typical solution
10(b)(i)	Obtains 0.3	1.1b	B1	$\frac{4.2-3}{5-1} = 0.3$
	Subtotal		**1**	

Q	Marking instructions	AO	Marks	Typical solution
10(b)(ii)	Uses $\ln B =$ their 0.3	1.1a	M1	$\ln B = 0.3$ $B = e^{0.3}$ $= 1.35$
	Obtains AWRT 1.35 Accept exact value.	1.1b	A1	
	Subtotal		**2**	

Q	Marking instructions	AO	Marks	Typical solution
10(b)(iii)	Writes one of • $\ln A = k$ • $\ln N = k$ • e^k where k is AWFW (2.6,2.8) PI by AWFW (13.46,16.45)	3.4	M1	$3 = \ln A + 1 \times 0.3$ $\ln A = 2.7$ $A = 14.9$ Initial number of newts released was 15
	Obtains AWFW (13.46,16.45)	1.1b	A1	
	States 14 or 15 Either of these must come from use of $k = 2.7$ or 2.68 unless NMS when 14 or 15 scores M1 A1 A1	3.2a	A1	
	Subtotal		**3**	

Q	Marking instructions	AO	Marks	Typical solution
10(b)(iv)	Forms an equation of the form $10Q = Q \times 1.35^t$ where Q is their A or their A rounded to the nearest integer and using their 1.35 Allow for example $150 = 14.9 \times 1.35^t$ Or $\ln 150 = \ln 14.9 + t \ln 1.35$ OE for example $\ln 150 = 2.7 + 0.3t$ using their 14.9 or 15 and 1.35 Or $10 = 1.35^t$ using their 1.35 Accept use of inequality	3.4	M1	$150 = 15 \times 1.35^t$ 8 years
	Obtains 8 Must come from a correct value of B=1.35 or $e^{0.3}$ OE and their value of A	3.2a	A1	
	Subtotal		**2**	

Q	Marking instructions	AO	Marks	Typical solution
10(c)	States an appropriate factor related to resource limitation or death and no incorrect factors For example Limited food Disease Limited habitat Death Predation	3.5c	E1	The model could be refined to account for disease.
	Subtotal		**1**	

	Question 10 Total		**12**	