Exponential Modelling Exam Questions MS

Q1, (OCR 4723, Jan 2006, Q6)

(a)	Either: State proportion $\frac{440}{275}$	**B1**		
	Attempt calculation involving proportion	**M1**		[involving multn and X value]
	Obtain 704	**A1**	**3**	
	Or: Use formula of form $275e^{kt}$ or $275a^t$	**M1**		[or equiv]
	Obtain $k = 0.047$ or $a = \sqrt[10]{1.6}$	**A1**		[or equiv]
	Obtain 704	**A1**	**(3)**	[allow ±0.5]
(b)(i)	Attempt correct process involving logarithm	**M1**		[or equiv including systematic trial and improvement attempt]
	Obtain $\ln\frac{20}{80} = -0.02t$	**A1**		[or equiv]
	Obtain 69	**A1**	**3**	[or greater accuracy; scheme for T&I: M1A2]
(ii)	Differentiate to obtain $ke^{-0.02t}$	**M1**		[any constant k different from 80]
	Obtain $-1.6e^{-0.02t}$ (or $1.6e^{-0.02t}$)	**A1**		[or unsimplified equiv]
	Obtain 0.88	**A1**	**3**	[or greater accuracy; allow –0.88]

Q2, (OCR 4723, Jun 2008, Q7)

(i)	State $A = 42$	**B1**		
	State $k = \frac{1}{9}$	**B1**		or 0.11 or greater accuracy
	Attempt correct process for finding m	**M1**		involving logarithms or equiv
	Obtain $\frac{1}{9}\ln 2$ or 0.077	**A1**		or 0.08 or greater accuracy
			4	
(ii)	Attempt solution for t using either formula	**M1**		using correct process (log'ms or T&I or …)
	Obtain 11.3	**A1**		or greater accuracy; allow 11.3 ± 0.1
			2	
(iii)	Differentiate to obtain form Be^{mt}	**M1**		where B is different from A
	Obtain $3.235e^{0.077t}$	**A1√**		or equiv; following their A and m
	Obtain 47.9	**A1**		allow 48 or greater accuracy
			3	

Q3, (OCR 4723, Jan 2009, Q5)

(i)	State 40	B1		
	Attempt value of k using 21 and 80	M1		or equiv
	Obtain $40e^{21k} = 80$ and hence 0.033	A1		or equiv such as $\frac{1}{21}\ln 2$
	Attempt value of M for $t = 63$	M1		using established formula or using exponential property
	Obtain 320	A1	**5**	or value rounding to this
(ii)	Differentiate to obtain $ce^{0.033t}$ or $40ke^{kt}$	M1		any constant c different from 40
	Obtain $40\times0.033e^{0.033t}$	A1√		following their value of k
	Obtain 2.64	A1	**3**	allow 2.6 or 2.64 ± 0.01 or greater accuracy (2.64056…)
			8	

Q4, (OCR 4723, Jan 2012, Q7)

(i)	(a)	State or imply $e^{-0.132t} = 0.25$	B1	or equiv such as $40e^{-0.132t} = 10$
		Attempt solution of eqn of form $e^{-0.132t} = k$	M1	using sound process; implied by correct ans; allow trial and improvement attempt
		Obtain 10.5	A1	or greater accuracy
			[3]	
(i)	(b)	Differentiate to obtain $ke^{-0.132t}$	M1	where k is a constant not equal to 40 (allow even if process looks like integration)
		Obtain $5.28e^{-0.132t}$ or $-5.28e^{-0.132t}$	A1	or (unsimplified) equiv
		Substitute 5 to obtain 2.73 or –2.73	A1	accept 2.7 or –2.7 or greater accuracy; allow 2.73 or –2.73 whatever it is claimed to be
			[3]	
(ii)		EITHER		
		Attempt to solve $40e^{2\lambda} = 31.4$ or $40e^{-2\lambda} = 31.4$	M1	using sound process; method implied by correct formula for mass of B obtained
		Obtain or imply $40e^{-0.12lt}$	A1	or greater accuracy (–0.12103..) or $0.5\ln 0.785$
		Substitute 3 to obtain 27.8	A1	accept 28 or greater accuracy
			[3]	
		OR		
		Attempt calculation involving multiplication of power of $\frac{31.4}{40}$	M1	
		Obtain $31.4\times(\frac{31.4}{40})^{0.5}$ or $40\times(\frac{31.4}{40})^{1.5}$	A1	
		Obtain 27.8	A1	accept 28 or greater accuracy

Q5, (OCR 4723, Jun 2014, Q5)

(a)		Differentiate to produce $ke^{-0.33t}$	M1	where constant k is different from 58
		Obtain $-19.14e^{-0.33t}$ or $19.14e^{-0.33t}$	A1	or unsimplified equiv
		Obtain -5.1 or 5.1	A1	whatever they claim value represents; accept 5.11 but not greater accuracy
			[3]	
(b)		Either:		
		State or imply formula $42e^{kt}$ or $42a^t$	B1	$42e^{-kt}$, $42e^{-kx}$, etc. also acceptable
		Attempt to find k from $42e^{6k}=51.8$ or a from $42a^6=51.8$	M1	using sound process involving logarithms at least as far as $6k=\ldots$ or $a=\ldots$
		Obtain $k=0.035$ or $a=1.0356$	A1	or greater accuracy 0.03495… or exact equiv $\frac{1}{6}\ln\frac{37}{30}$
		Substitute 24 to obtain value between 97.1 and 97.3 inclusive	A1	allow greater accuracy than 3 s.f.
		Or:		
		Use ratio $\frac{51.8}{42}$ in calculation	B1	
		Attempt calculation of form $42\times r^n$	M1	
		Obtain $42\times(\frac{51.8}{42})^4$ or $51.8\times(\frac{51.8}{42})^3$	A1	
		Obtain value between 97.1 and 97.3 inclusive	A1	allow greater accuracy than 3 s.f.
			[4]	

Q6, (OCR 4723, Jun 2016, Q3)

i		Obtain 128 for value corresponding to 10	B1	Allow any value rounding to 128
		Obtain 65.5 for value corresponding to 25	B1	Allow any value rounding to 65 or 66; whether obtained using powers of 0.8 or by use of formula
			[2]	
ii		Attempt to find formula for m of form $200e^{kt}$ or $200\times r^{\lambda t}$	M1	Whether attempted in part (i) or (ii)
		Obtain $200e^{(0.2\ln 0.8)t}$ or $200e^{-0.0446t}$ or $200\times0.8^{0.2t}$ or 200×0.956^t	A1	Or equiv
		Show correct process for solving equation of form $200e^{kt}=50$ or $200r^{\lambda t}=50$	M1	
		Obtain 31	A1	Or greater accuracy rounding to 31; ignore any units given; second M1 is implied by correct answer
			[4]	