Modelling With Exponentials MS (From OCR MEI 4752)

Q1, (Jan 2006, Q9)

(i) $\log_{10} y = 0.5x + 3$	B3	B1 for each term scored in either part	
(ii) $y = 10^{0.5x+3}$ isw	2	o.e. e.g. $y = 1000 \times 10^{\sqrt{x}}$	5

Q2, (Jun 2006, Q12)

i	$\log_{10} P = \log_{10} a + \log_{10} 10^{bt}$ $\log_{10} 10^{bt} = bt$ intercept indicated as $\log_{10} a$	B1 B1 B1	condone omission of base	3	
ii	3.9(0), 3.94, 4(.00), 4.05, 4.11 plots ft line of best fit ft	T1 P1 L1	to 3 sf or more; condone one error 1 mm ruled and reasonable	3	
iii	(gradient =) 0.04 to 0.06 seen (intercept =) 3.83 to 3.86 seen (a =) 6760 to 7245 seen $P = 7000 \times 10^{0.05t}$ oe	M1 M1 A1 A1	 7000×1.12^t SC $P = 10^{0.05t + 3.85}$ left A2	4	
iv	17 000 to 18 500	B2	14 000 to 22 000 B1	2	12

Q3, (Jun 2008, Q13)

i	$\log P = \log a + b \log t$ www comparison with $y = mx + c$ intercept = $\log_{10} a$	1 1 1	 must be with correct equation condone omission of base	3
ii	$\log t$ 0 0.78 1.15 1.18 1.20 $\log P$ 1.49 1.64 1.75 1.74 1.76 plots f.t. ruled line of best fit	1 1 1 1	accept to 2 or more dp	4
iii	gradient rounding to 0.22 or 0.23 $a = 10^{1.49}$ s.o.i. $P = 31t^{m}$ allow the form $P = 10^{0.22\log t + 1.49}$	2 1 1	M1 for y step / x-step accept1.47 – 1.50 for intercept accept answers that round to 30 – 32 , their positive m	4
iv	answer rounds in range 60 to 63	1		1

Q4, (Jun 2012, Q6)

gradient = 3 seen	B1	may be embedded
$\log_{10} y - 5 = (\text{their } 3)(\log_{10} x - 1)$ or using (5, 17)	M1	or $\log_{10} y = 3\log_{10} x + c$ and substitution of (1, 5) or (5, 17) for $\log_{10} x$ and $\log_{10} y$
$\log_{10} y = 3\log_{10} x + 2$ oe	A1	
$y = 10^{3\log_{10} x + 2}$ oe	M1	or $\log_{10} y = \log_{10} x^3 + \log_{10} 100$
$y = 100x^3$	A1 [5]	

Q5, (Jun 2009, Q10)

i	0.6(0..), 0.8(45..), [1], 1.1(76..) 1.3(0..), 1.6(0..)	T 1	Correct to 2 d.p. Allow 0.6, 1.3 and 1.6	
	points plotted correctly f.t.	P1		
	ruled line of best fit	L1	tol. 1 mm	3
ii	*b* = their intercept	M1		
	a = their gradient	M1		
	-11 ≤ b ≤ -8 *and* 21 ≤ a ≤ 23.5	A1		3
iii	34 to 35 m	1		1
iv	29 = "22"logt – "9"	M1		
	t = $10^{\text{"1.727.."}}$	M1		
	55 [years] approx	A1	accept 53 to 59	3
v	For small t the model predicts a negative height (or h = 0 at approx 2.75)	1		
	Hence model is unsuitable	D1		2

Q6, (Jun 2014, Q13)

(i)	$\log_{10}h = \log_{10}a + bt$ www $m = b$, $c = \log_{10}a$	B1 B1 **[2]**	
(ii)	–0.15, 0[.00], 0.23, 0.36, 0.56, 0.67, 0.78, 0.91, 1.08, 1.2[0] plots correct (tolerance half square) single ruled line of best fit for values of x from 5 to 50 inclusive	B2 B1 B1 **[4]**	B1 if 1 error condone 1 error – see overlay line must not go outside overlay between $x = 5$ and $x = 50$
(iii)	$-0.3 \le$ y-intercept ≤ -0.22 valid method to find gradient of line $h = \text{their}a \times 10^{\text{their}bt}$ or $h = 10^{\text{their}\log a + \text{their}bt}$ $0.028 \le b \le 0.032$ and $0.5 \le a \le 0.603$ or $-0.3 \le \log a \le -0.22$	B1 M1 M1 A1 **[4]**	may be implied by $0.5 \le a \le 0.603$ may be embedded in equation; may be implied by eg m between 0.025 and 0.035
(iv)	$a10^{60b} - a10^{50b}$ their values for a and b 8.0 to 26.1 inclusive	M1 A1 **[2]**	or $10^{\log a + b\times60} - 10^{\log a + b\times50}$ or their values for $\log a$ and b
(v)	comment on the **continuing reduction** in thickness **and** its consequences	B1 **[1]**	eg in long term, it predicts that reduction in thickness will continue to increase, even when the glacier has completely melted

Q7, (Jun 2015, Q8)

$m = 3$ seen	**B1**	
$\log y = m\log x + 2$ or $\log y = m\log x + \log 100$	**M1**	or $\log y - 8 = m(\log x - 2)$
$\log y = \log x^3 + 2$ or $\log y = \log x^3 + \log 100$ or better	**M1**	or $10^{\log y} = 10^{3\log x + 2}$ or $10^{3\log x + \log 100}$ or better
$y = 100x^3$ or $y = 10^{3\log x + 2}$ or $y = 10^{\log x^3 + 2}$ www isw	**A1** **[4]**	$y = 10^{3\log x + \log 100}$ or $y = 10^{\log x^3 + \log 100}$

Q8, (Jun 2016, Q11)

(i)		$\log_{10} y = \log_{10} a + bt$ www	**B1**	**B0** for just $\log_{10} y = \log_{10} a + bt \log_{10} 10$
		gradient is b, intercept is $\log_{10} a$ cao	**B2** **[3]**	**B1** for one correct; award independently of their equation; must be stated – linking by arrows etc is insufficient; condone $m = b$ and $c = \log a$
(ii)		1.58, 1.8[0], 1.98, 2.37, 2.68	**B1**	allow values which round to these numbers to 2 dp;
		all values correct and all plotted accurately	**B1**	within tolerance on overlay;
		ruled line of best fit for at least $1 \le t \le 10$	**B1**	within tolerance on overlay: must not cut red or green line; line between (1, 0.6) and (1, 1.05) at lower limit and between (10, 2.3) and (10, 2.75) at upper limit;
		evaluation of $\dfrac{\log y_2 - \log y_1}{t_2 - t_1}$ or substitution of $(t_1,\ \log y_1)$ and $(t_2,\ \log y_2)$ in $\log y = bt + \log a$ to obtain a numerical value for the gradient	**M1**	$(t_1,\ \log y_1)$ and $(t_2,\ \log y_2)$ are points on their line
		$0.14 \le b \le 0.24$	**A1**	gradient must be identified as b for **A1**
		$2.5 \le a \le 6.3$	**B1**	must be identified as a ; not from wrong working
		$y =$ their $a \times 10^{\text{their}b\times t}$ or $y = 10^{\text{their}bt\ +\ \text{their}\log a}$ or $10^{\text{their}\log a} \times 10^{\text{their}b\times t}$ oe	**M1**	
		a and b or $\log a$ and b both in acceptable range	**A1** **[8]**	$0.4 \le \log a \le 0.8$
(iii)		260 **or** 261	**B1** **[1]**	**B0** for non-integer answer