QUESTION NUMBER

DO NOT WRITE IN THIS MARGIN

13.(a)

$$C_{30} = 11e^{-0.0053 \times 30}$$

$$= 9.38$$

13.(b)

$$0.66 = 11e^{-0.0053t}$$

$$0.06 = e^{-0.0053t}$$

$$-0.0053t = \ln 0.06$$

$$t = \frac{\ln 0.06}{-0.0053}$$

$$t = 530.83 \text{ Minutes}$$

Question			Generic scheme	Illustrative scheme	Max mark
13.	(a)		•[1] calculate concentration	•[1] 9.38… (mg/l)	**1**
Notes:					
1. Accept any answer which rounds to 9.4 for •[1].					
Commonly Observed Responses:					
	(b)		•[2] substitute •[3] write in logarithmic form •[4] process for t	•[2] $0.66 = 11 \times e^{-0.0053\,t}$ •[3] $\log_e \frac{0.66}{11} = -0.0053t$ •[4] 530.83… (minutes)	**3**
Notes:					
2. Where values other than 0.66 are used in the substitution, •[3] and •[4] are still available. 3. Evidence for •[3] must be stated explicitly. 4. At •[3] all exponentials must be processed. 5. Any base may be used at •[3] stage - see Candidate A. 6. Accept $\ln 0.06 = -0.0053t \ln e$ for •[3]. 7. Accept any answer where $530 \le t \le 532$ at •[4]. 8. •[4] is unavailable where a candidate rounds the value of $\ln 0.06$ to fewer than 2 decimal places. 9. The calculation at •[4] must follow from the valid use of exponentials and logarithms at •[2] and •[3]. 10. For candidates with no working or who take an iterative approach to arrive at $t = 532$, $t = 531$ or $t = 530$ award 1/3. However, if, in any iterations C_t is evaluated for $t = 530$ and $t = 531$ leading to a final answer of $t = 531$ (minutes) then award 3/3.					
Commonly Observed Responses:					

Candidate A		**Candidate B**	
$0.66 = 11e^{-0.0053t}$	•[2] ✓	$0.66 = 11e^{-0.0053t}$	•[2] ✓
$0.06 = e^{-0.0053t}$		$t = 531$ minutes	•[3] ^ •[4] ✓[1]
$\log_{10} 0.06 = -0.0053t \log_{10} e$	•[3] ✓		
$t = 531$ minutes	•[4] ✓		