

Question	Scheme	Marks	AOs
5(a)	Pond contains $1000 + 5t$ litres after t days	M1	3.3
	If x is the amount of pollutant in the pond after t days		
	Rate of pollutant out = $20 \times \frac{x}{1000 + 5t}$ g per day	M1	3.3
	Rate of pollutant in = 25×2 g = 50g per day	B1	2.2a
	$\frac{dx}{dt} = 50 - \frac{4x}{200 + t}$ *	A1*	1.1b
	(4)		
(b)	$I = e^{\int \frac{4}{200+t} dt} = (200+t)^4 \Rightarrow x(200+t)^4 = \int 50(200+t)^4 dt$	M1	3.1b
	$x(200+t)^4 = 10(200+t)^5 + c$	A1	1.1b
	$x = 0, t = 0 \Rightarrow c = -3.2 \times 10^{12}$	M1	3.4
	$t = 8 \Rightarrow x = 10(200+8) - \frac{3.2 \times 10^{12}}{(200+8)^4}$	M1	1.1b
	$= 370$ g	A1	2.2b
	(5)		
(c)	e.g. <ul style="list-style-type: none"> The model should take into account the fact that the pollutant does not dissolve throughout the pond upon entry The rate of leaking could be made to vary with the volume of water in the pond 	B1	3.5c
		(1)	

(10 marks)

Notes:

- (a)**
M1: Forms an expression of the form $1000 + kt$ for the volume of water in the pond at time t
M1: Expresses the amount of pollutant out in terms of x and t
B1: Correct interpretation for pollutant entering the pond
A1*: Puts all the components together to form the correct differential equation
- (b)**
M1: Uses the model to find the integrating factor and attempts solution of their differential equation
A1: Correct solution
M1: Interprets the initial conditions to find the constant of integration
M1: Uses their solution to the problem to find the amount of pollutant after 8 days
A1: Correct number of grams
- (c)**
B1: Suggests a suitable refinement to the model