Question	Scheme	Marks	AOs
8(a)	$(k =)\ 0.8$	B1	1.1b
		(1)	
(b)	$1 = 0.8 + 1.4\mathrm{e}^{-0.5t} \Rightarrow 1.4\mathrm{e}^{-0.5t} = 0.2$	M1	3.1b
	$-0.5t = \ln\left(\dfrac{0.2}{1.4}\right) \Rightarrow t = ...$	M1	1.1b
	awrt 3.9 minutes	A1	1.1b
		(3)	
(c)	$\left(\dfrac{\mathrm{d}P}{\mathrm{d}t} =\right) -0.7\mathrm{e}^{-0.5t}$ $\left(\dfrac{\mathrm{d}P}{\mathrm{d}t}\right)_{t=2} = -0.7\mathrm{e}^{-0.5\times 2}$	M1	3.1b
	= awrt 0.258 (kg/cm^2 per minute)	A1	1.1b
		(2)	
			(6 marks)

Notes

(a)

B1: Completes the equation for the model by obtaining $(k =)\ 0.8$ or equivalent.

(b) ***Be aware this could be solved entirely using a calculator which is not acceptable***

M1: For using the model with $P = 1$ and their value for k from (a) and proceeding to $A\mathrm{e}^{\pm 0.5t} = B$. Condone if A or B are negative for this mark.

M1: Uses correct log work to solve an equation of the form $A\mathrm{e}^{\pm 0.5t} = B$ leading to a value for t. They cannot proceed directly to awrt 3.9 without some intermediate working seen.

Eg $t = 2\ln 7$ or $-2\ln\left(\dfrac{1}{7}\right)$ is acceptable.

Also allow $1.4\mathrm{e}^{-0.5t} = 0.2 \Rightarrow -0.5t = -1.9459... \Rightarrow t = ...$

This cannot be scored from an unsolvable equation (eg when their k …1so that $\mathrm{e}^{\pm 0.5t}$,, 0).

A1: Accept awrt 3.9 minutes or t = awrt 3.9 with correct working seen.
eg $1.4\mathrm{e}^{-0.5t} = 0.2 \Rightarrow t = 3.9$ would be M1M0A0

(c) ***Be aware this can be solved entirely using a calculator which is not acceptable***

M1: Links rate of change to gradient and differentiates to obtain an expression of the form $A\mathrm{e}^{-0.5t}$ and substitutes $t = 2$. Do not accept $At\mathrm{e}^{-0.5t}$ as the derivative.
Beware that substituting $t = 2$ and proceeding from e^{-1} to e^{-2} is M0A0

A1: Obtains awrt 0.258 with differentiation seen. (Units not required) Condone awrt -0.258
Awrt ± 0.258 with no working is M0A0. Isw after a correct answer is seen.

(Ignore in (c) any spurious notation on the LHS when differentiating such as P = …. or $\dfrac{\mathrm{d}y}{\mathrm{d}x} = ...$)