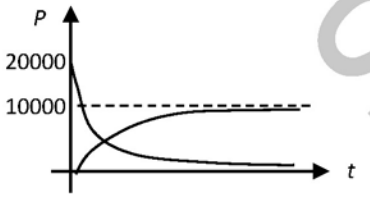
10	**(a)**	**(i)**		**M1** **M1**	**1.1** **1.1**	P_G shape through O P_R shape through (0, 20000), [condone graphs for –ve t]	
		(ii)	asymptote for $P_G = 10\,000$	**A1**	**2.2a**	Or $p = 10\,000$	
			Asymptote for $P_R = 0$	**A1**	**2.2a**	Or $p = 0$	
				[4]			

Question			Answer	Marks	AOs	Guidance	
10	(b)		Red squirrels zero Grey 10 000	**B1** **B1** **[2]**	**3.4** **3.4**		
10	(c)		One relevant comment evaluating the validity of the model	**B1** **[1]**	**3.5a**	E.g. One of • Grey population increases as would be expected [since grey squirrels are larger and more successful] • Red population decreases as would be expected [since red squirrels have to compete with the larger grey squirrels for food] • Number of squirrels tends to a limit as would be expected [since there is limited food and space] • Would expect grey population to grow slower at first • Would expect red population to fall slower at first	

Question			Answer	Marks	AOs	Guidance	
10	(d)			M1	3.1b	Attempts to differentiate either or both	
			$\frac{dP_G}{dt} = 10\,000ke^{-kt}$	A1	1.1		
			$\frac{dP_R}{dt} = -20\,000ke^{-kt}$	A1	1.1		
			so $\frac{dP_R}{dt} = -2\frac{dP_G}{dt}$	E1	2.1	Or in words	
				[4]			
10	(e)		$10\,000(1-e^{-3k}) = 20\,000e^{-3k}$ $\Rightarrow 1-e^{-3k} = 2e^{-3k}$	M1	1.1a		
			$\Rightarrow e^{-3k} = \frac{1}{3}$	A1	1.1		
			$\Rightarrow -3k = \ln\left(\frac{1}{3}\right)$	M1	1.1	Taking natural logs of both sides	
			$\Rightarrow k = -\frac{1}{3}\ln\left(\frac{1}{3}\right) = 0.366$ or $\frac{1}{3}\ln 3$	A1	2.1	cao	
				[4]			