

**Note:** Partial credit can not be awarded unless there is legible work to assess. Feel free to use the back of this page if you require additional space for your solutions.

1. Consider the following first order system of differential equations

$$\begin{aligned}\frac{dx}{dt} &= -2x - y \\ \frac{dy}{dt} &= 2x - 5y\end{aligned}$$

- (i) Rewrite the system in matrix form.
- (ii) Show that  $\mathbf{Y}_1(t) = (e^{-3t}, e^{-3t})$  is a solution of the system.
- (iii) The function  $\mathbf{Y}_2(t) = (e^{-4t}, 2e^{-4t})$  is also a solution. (You **do not** need to verify this.) Show that  $\mathbf{Y}_1$  and  $\mathbf{Y}_2$  are linearly independent solutions.
- (iv) Give the general solution of the system.

**Bonus:** Find the particular solution to this system for which  $\mathbf{Y}(0) = (2, 3)$ .

2. Find two linearly independent straight-line solutions for the following system of differential equations.

$$\frac{d\mathbf{Y}}{dt} = \begin{pmatrix} 4 & 6 \\ 0 & 7 \end{pmatrix} \mathbf{Y}$$