Question	Scheme	Marks	AOs
8(a)	$-7.5 + 2(0) + \lambda(1.5) = 0 \Rightarrow \lambda = \cdots$	M1	3.3
	$\lambda = 5$ *	A1*	1.1b
		(2)	
(b)	Solves $m^2 + 2m + 5 = 0 \Rightarrow m = \ldots$	M1	3.1b
	$m = -1 \pm 2\text{i}$	A1ft	1.1b
	$x = \text{e}^{-t}(A\cos 2t + B\sin 2t)$	A1	1.1b
	Using the initial conditions, $x = 1.5, t = 0$ to find a constant $1.5 = \text{e}^0(A\cos 0 + B\sin 0) \Rightarrow A = \ldots\{1.5\}$	M1	3.4
	$\frac{dx}{dt} = -\text{e}^{-t}(A\cos 2t + B\sin 2t) + \text{e}^{-t}(-2A\sin 2t + 2B\cos 2t)$	M1	1.1b
	Using the initial conditions, $v = 0, t = 0$ to find the second constant $0 = -\text{e}^0(1.5\cos 0 + B\sin 0) + \text{e}^0(-3\sin 0 + 2B\cos 0)$ $\Rightarrow B = \ldots\{0.75\}$	dM1	3.4
	$x = e^{-t}(1.5\cos 2t + 0.75\sin 2t)$	A1	1.1b
		(7)	
(c)	Substitutes $t = 4.5$ into their equation for x $(x = -0.0117\ldots)$	M1	3.4
	Compares their value of x with 0 and evaluates the model	A1ft	3.5a
		(2)	
(d)	e. g. Take into account air resistance	B1	3.5c
		(1)	
			(12 marks)

Notes:

(a)
M1: Substitutes $\ddot{x} = -7.5$, $\dot{x} = 0$ and $x = 1.5$ into the differential equation to find a value for λ
A1*: Correct solution only

(b)
M1: Forms and solves the auxiliary equation
A1ft: Correct solution to their auxiliary equation. Follow through on their value of λ only.
A1: Correct complementary function
M1: Uses the information from the model $x = 1.5, t = 0$ to find a constant
M1: Differentiates to find an expression for the velocity
dM1: Uses the information from the model, $v = 0, t = 0$ to find another equation for the constants.
A1: Correct equation for displacement

(c)
M1: Substitutes to find a value of x

A1ft: Any suitable comment consistent with their value e.g. a good model since only 1cm out
(d) **B1:** A suitable refinement of the model e.g. air resistance