Question	Scheme	Marks	AOs
6(a)	$5k(13.6)+2k(0)+17(-20)=0 \Rightarrow k=...$	M1	3.3
	$k=5$	A1	1.1b
		(2)	
(b)	Solves their $25m^2+10m+17=0 \Rightarrow m=...$	M1	3.1b
	$m=-0.2\pm 0.8\text{i}$	A1	1.1b
	$x=\text{e}^{-0.2t}\left(A\cos 0.8t+B\sin 0.8t\right)$	A1ft	1.1b
	$t=0,\ x=-20 \Rightarrow A=...\ (=-20)$	M1	3.4
	$\frac{\text{d}x}{\text{d}t}=-0.2\text{e}^{-0.2t}\left(A\cos 0.8t+B\sin 0.8t\right)$ $+\text{e}^{-0.2t}\left(-0.8A\sin 0.8t+0.8B\cos 0.8t\right)$	M1	1.1b
	$t=0\ \frac{\text{d}x}{\text{d}t}=0 \Rightarrow -0.2A+0.8B=0 \Rightarrow B=...\ (=-5)$	dM1	3.4
	$x=\text{e}^{-0.2t}\left(-20\cos 0.8t-5\sin 0.8t\right)$ o.e.	A1	1.1b
		(7)	
(c)	Vertical height $=30+\left[\text{e}^{-0.2\times 15}\left(-20\cos(0.8\times 15)-5\sin(0.8\times 15)\right)\right]$	M1	3.4
	Vertical height = awrt 29.3 m	A1	2.2b
		(2)	
(d)	For example It is unlikely that the rope will remain taut The model predicts the tourist will continue to move up and down, (but in fact they will lose momentum) The tourist is modelled as a particle	B1	3.5b
		(1)	
			(12 marks)

Notes:

(a)

M1: Substitutes $\frac{\text{d}^2x}{\text{d}t^2}=13.6\ \ \frac{\text{d}x}{\text{d}t}=0$ and $x=-20$ into the differential equation to find a value for *k*.
Allow if there are sign slips but must be attempting the values in the correct places.
A1: Correct value $k=5$

(b)
M1: Forms and solves the auxiliary equation.
A1: Correct solution to the auxiliary equation (not follow through).
A1ft: Correct complementary function for their solutions to their auxiliary equation. (Follow through on distinct real, repeated or complex roots.)

M1: Uses the information from the model $t = 0\ x = -20$ to find a constant or equation linking two constants in their equation.

M1: Differentiates an expression of the form $e^{kt}\left(A\cos\lambda_1 t + B\sin\lambda_2 t\right)$ using the product rule to find an expression for the velocity.

dM1: Uses the information from the model, $t = 0\ \frac{dx}{dt} = 0$ to find and solve another equation for the constants.

A1: Correct equation for displacement.

(c)

M1: Finds the height above the river by finding the displacement after 15 seconds and adding 30

A1: Vertical height = awrt 29.3 m

(d)

B1: Any suitable comment relating to the given model or the outcomes of it. See scheme for examples. Do not accept just "air resistance has not been considered" as the question does not say this was ignored. However, if a valid consequence of what including air resistance would mean to the model, then the mark may be awarded.