Question	Scheme	Marks	AOs
10(a)	$x=4, y=2 \Rightarrow t=-1$	B1	2.2a
	$\frac{dy}{dx}=\frac{dy}{dt}\times\frac{dt}{dx}=-3t^2\times\frac{1}{2(t+3)}$	M1	1.1b
	$\frac{dy}{dx}=-3(-1)^2\times\frac{1}{2(-1+3)}=-\frac{3}{4}$	M1	1.1b
	$\Rightarrow y-2=-\frac{3}{4}(x-4)$ or $\Rightarrow y=-\frac{3}{4}x+c \to 2=-\frac{3}{4}\times 4+c \Rightarrow c...$	ddM1	2.1
	$y-2=-\frac{3}{4}(x-4)\Rightarrow 4y-8=-3x+12$ or $c=5\Rightarrow y=-\frac{3}{4}x+5$ $\Rightarrow 3x+4y=20*$	A1*	1.1b
		(5)	
(b)	Maximum height is 9m	B1	3.4
		(1)	
			(6 marks)

Notes

(a) <u>**If parametric differentiation is not used in part (a) (e.g. uses Cartesian form) then only the B mark is available but see alternative below.**</u>

B1: Uses the given Cartesian coordinates to deduce the correct value for t.
If more than one value for t e.g. $t=-5$ is given and $t=-1$ is not "selected" score B0 but if **just** $t=-1$ is used subsequently allow recovery and score B1

M1: Attempts to use $\frac{dy}{dx}=\frac{dy}{dt}\times\frac{dt}{dx}$ or equivalent with their differentiated equations.
There must be an attempt to differentiate both parameters, however poor, and divide or multiply correctly so using $\frac{dy}{dx}=\frac{y}{x}$ scores M0. Both parameters must be "changed".

Condone confusion with the variables e.g. referring to $\frac{dy}{dt}$ as $\frac{dy}{dx}$ if the intention is clear.

This may be implied by e.g. $\frac{dy}{dt}=-3t^2,\ \frac{dx}{dt}=2(t+3), t=-1, \frac{dy}{dt}=-3, \frac{dx}{dt}=4\Rightarrow\frac{dy}{dx}=-\frac{3}{4}$

M1: Uses their numerical value of t (not 4) in their $\frac{dy}{dx}$ to obtain a value.

Condone attempts with different values of t e.g. $t=-1$ and $t=-5$

ddM1: Applies a correct straight line method with their value of $\frac{dy}{dx}$ which has come from an attempt to use parametric differentiation with their value of t (not 4) and with x = 4 and y = 2 correctly placed. An attempt at the equation of the normal is M0.
If using $y = mx + c$ they must reach as far as $c = \ldots$
Depends on both previous M marks.

A1*: Correct equation as printed with no errors but condone $4y+3x=20*$
Allow equivalents e.g. $20=4y+3x*$ or $3x+4y=20*$
This is a printed answer so there must be at least one intermediate step as shown in the main scheme.

Alternative for (a) using parametric differentiation but avoids the need for a value for *t*:

$$\frac{dy}{dx}=\frac{dy}{dt}\times\frac{dt}{dx}=-3t^2\times\frac{1}{2(t+3)}$$

$$-3t^2\times\frac{1}{2(t+3)}=-3(1-y)^{\frac{2}{3}}\times\frac{1}{2\sqrt{x}}=-3(1-2)^{\frac{2}{3}}\times\frac{1}{2\sqrt{4}}=-\frac{3}{4}$$

or

$$-3t^2\times\frac{1}{2(t+3)}=-3\left(\sqrt{x}-3\right)^2\times\frac{1}{2\sqrt{x}}=-3(2-3)^2\times\frac{1}{2\sqrt{4}}=-\frac{3}{4}$$

or

$$-3t^2\times\frac{1}{2(t+3)}=-3(1-y)^{\frac{2}{3}}\times\frac{1}{2\left((1-y)^{\frac{1}{3}}+3\right)}=-3(1-2)^2\times\frac{1}{2\times2}=-\frac{3}{4}$$

$$\Rightarrow y-2=-\frac{3}{4}(x-4)\Rightarrow 3x+4y=20*$$

B1: **Either** a correct expression for $\frac{dy}{dx}$ in terms of *x* and/or *y* following a correct $\frac{dy}{dx}$ in terms of *t* **or** for $t=-1$ seen anywhere.

M1: Attempts to use $\frac{dy}{dx}=\frac{dy}{dt}\times\frac{dt}{dx}$ with their differentiated equations.
There must be an attempt to differentiate both parameters, however poor, and divide or multiply correctly so using $\frac{dy}{dx}=\frac{y}{x}$ scores M0
Condone confusion with the variables e.g. referring to $\frac{dy}{dt}$ as $\frac{dy}{dx}$ if the intention is clear.
This may be implied by e.g. $\frac{dy}{dt}=-3t^2,\ \frac{dx}{dt}=2(t+3), t=-1,\ \frac{dy}{dt}=-3, \frac{dx}{dt}=4\Rightarrow\frac{dy}{dx}=-\frac{3}{4}$

M1: Attempts to express their $\frac{dy}{dx}$ which is in terms of *t*, in terms of *x* and/or *y* **and** uses *x* = 4 and *y* = 2 correctly placed in an attempt to find the gradient of the tangent.

ddM1: Applies a correct straight line method with their value of $\frac{dy}{dx}$ which has come from an attempt to use parametric differentiation with their gradient and with *x* = 4 and *y* = 2 correctly placed.
If using *y* = *mx* + *c* they must reach as far as *c* = …
Depends on both previous M marks.

A1*: Correct equation as printed with no errors.
This is a printed answer so there must be at least one intermediate step as shown in the main scheme.

(b)

B1: 9m or equivalent **including correct units**. Accept e.g. 9 metres, 900cm etc.