

Question	Scheme	Marks	AOs
11(a)	$h = 2.3 - 1.7e^0$	M1	3.4
	Either 0.6 {m} or 60 cm	A1	1.1b
		(2)	
(b)	$\left\{ \frac{dh}{dt} = \right\} 0.34e^{-0.2t}$	M1	3.1b
	At $t = 4 \Rightarrow$ Rate of growth is $0.34e^{-0.2 \times 4} = 0.15277... \{m / year\}$	dM1	3.4
	0.153 {m per year} = 15.3 cm {per year} *	A1*	1.1b
		(3)	
(c)	2.3 (m)	B1	2.2a
		(1)	

(6 marks)

Notes:

(a)

M1: Substitutes $t = 0$ into $h = 2.3 - 1.7e^{-0.2t}$ Implied by e.g., $h = 2.3 - 1.7e^{-0}$ or $h = 0.6$

A1: Allow 0.6, 0.6 m, or 60 cm and isw after a correct height. Allow $\frac{3}{5}$

The M mark may be implied by A1.

(b)

M1: Links rate of change to gradient and differentiates $h = 2.3 - 1.7e^{-0.2t}$ to $ke^{-0.2t}$, $k \neq -1.7$

Accept, e.g., $-0.2 \times -1.7e^{-0.2t}$ Must be seen in (b).

dM1: Substitutes $t = 4$ into $ke^{-0.2t}$, $k \neq -1.7$ and calculates its value.

A1*: Fully correct. Requires

- sight of $\left\{ \frac{dh}{dt} = \right\} 0.34e^{-0.2t}$ o.e., e.g., $\left\{ \frac{dh}{dt} = \right\} \frac{17}{50} e^{-0.2t}$ or $\left\{ \frac{dh}{dt} = \right\} -0.2 \times -1.7e^{-0.2t}$
- $\left\{ \frac{dh}{dt} = \right\}$ awrt 0.153 {metres per year}
- changing to awrt 15.3 cm {per year}.

Note: Substituting $t = 4$ into $h = 2.3 - 1.7e^{-0.2t}$ gives $h = 1.536...$ scores M0dM0A0 unless differentiation and further correct work is seen separately.

(c)

B1: Allow 2.3, 2.3 m, or 230 cm

2.29 and 2.2999... which clearly continues are both acceptable, but 2.29999999 is not.