Question	Scheme	Marks	AOs
11(a)	At $t = 0$, $V_A = 100 + 20 = 120 \Rightarrow p = 2 \times "120"$	M1	1.1b
	$(p =)\ 240$	A1	1.1b
		(2)	
(b)	$...e^{0.04T} = ...e^{-0.02T}$	M1	3.1b
	$0.8e^{0.04T} = "4.8"e^{-0.02T}$	A1ft	1.1b
	$...e^{0.04T} = ...e^{-0.02T} \Rightarrow e^{\pm 0.06T} = ...$	dM1	3.1a
	$(T =)$ awrt 29.9 (months)	A1cso	1.1b
		(4)	
			(6 marks)

Notes

(a)

M1: Attempts to find the price per gram of metal *A* at $t = 0$, and then doubles this to find the value of *p*. Can be implied by 240. An expression must be evaluated to score this mark

A1: 240 only (withhold this mark if they find $V_B = 240$ but proceed to state *p* as a different value)

(b) Candidates who state that $\frac{dV_B}{dt} = "4.8"e^{-0.02T}$ can still score full marks question (they had already determined that they needed to take the modulus of the gradient function)

May be in terms of *t* or *T*

M1: Attempts to set $\pm\frac{dV_A}{dt}$ equal to $\pm\frac{dV_B}{dt}$. Look for an equation of the form $pe^{0.04T} = qe^{-0.02T}$ where *p* and *q* are constants or may be implied by further work. e.g. $e^{\pm 0.06T} = ...$ (it cannot be for awrt 29.9). Do not allow $...Te^{0.04T} = ...Te^{-0.02T}$

A1ft: $0.8e^{0.04T} = "4.8"e^{-0.02T}$. Follow through on their positive value for *p*.

May be implied by further work which is not awrt 29.9.

dM1: Rearranges their $\frac{dV_A}{dt} = -\frac{dV_B}{dt}$ which cannot be the original functions to $re^{\pm 0.06T} = s$ where $r \times s > 0$

$\frac{dV_B}{dt} = "4.8"e^{-0.02T} \Rightarrow 0.8e^{0.04T} = "4.8"e^{-0.02T}$ is allowed (see note at the start of (b).

Condone slips. It is dependent on the first method mark.

If they take lns of both sides first

e.g. $0.8e^{0.04T} = "4.8"e^{-0.02T} \Rightarrow \ln 0.8 + 0.04T = \ln "4.8" - 0.02T$ they need to rearrange to $\pm 0.06T = ...$ by adding / subtracting.

A1cso: awrt 29.9 provided evidence of solving $0.8e^{0.04T} = 4.8e^{-0.02T}$ is seen. i.e. they cannot proceed from $e^{\pm 0.06T} = ...$ to the awrt 29.9 in one step. We must see either an expression for t or e.g. taking lns of both sides.

Condone $(T =) \frac{50 \ln 6}{3}$ or others in the form $(T =)\ a \ln b$ where a and b are rational constants e.g. $\frac{\ln 6}{0.06}$. It cannot be scored for an expression.