Question	Answer	Marks	Guidance
(a)	Separate variables correctly	**B1**	$\frac{\mathrm{d}N}{N^{\frac{3}{2}}} = (k\cos 0.02t)\,\mathrm{d}t$ Allow without integral signs.
	Obtain term $-\frac{2}{\sqrt{N}}$	**B1**	OE Ignore position of k.
	Obtain term $50\sin 0.02t$	**B1**	OE Ignore position of k.
	Use $t = 0$, $N = 100$ to evaluate a constant, or as limits, in a solution containing terms $\frac{a}{\sqrt{N}}$ and $b\sin 0.02t$, where $ab \neq 0$	**M1**	$\left[\text{e.g. } c = -0.2 \quad \text{or} \quad c = \frac{-0.2}{k}\right]$
	Obtain correct solution in any form, e.g. $-\frac{2}{\sqrt{N}} = 50k\sin 0.02t - 0.2$	**A1**	OE ISW e.g. $N = \frac{1}{(25k\sin 0.02t - 0.1)^2}$ $-2N^{-\frac{1}{2}} = \frac{k}{0.02}\sin 0.02t - \frac{1}{5}$ $50k\sin 0.02t = -\frac{2}{\sqrt{N}} + \frac{1}{5}$ $\frac{1}{\sqrt{N}} = -\frac{1}{2}k(50\sin 0.02t) + \frac{1}{10}$ $50\sin\left(\frac{1}{50}t\right) = -\frac{2\sqrt{N}}{kN} + \frac{20}{100k}$
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(b)	Use the substitution $N = 625$ and $t = 50$ in expression of appropriate form to evaluate k	**M1**	Expression must contain $a + bk\sin 0.02t$, $(\sqrt{N})^{\pm n}$, where $n = -1$, 1, 3 or 5 and a and b are constants $ab \neq 0$ or $(a + bk\sin 0.02t)^{\pm 2}$ and $(N)^{\pm n}$. Allow with k replaced by $\frac{1}{k}$, error due to $k(N^{-3/2})$ when separating variables in **8(a)**. If invert term by term when 3 terms shown then M0.
	Obtain $k = 0.00285[2148]$	**A1**	Must evaluate sin1. Degrees $k = 0.138$ M1 A0.
		2	

Question	Answer	Marks	Guidance
(c)	Rearrange and obtain $N = 4(0.2 - 0.142(607)\sin 0.02t)^{-2}$ Substitution for k required	**M1**	Anything of the form $N = c(d - ek\sin 0.02t)^{-2}$, where c, d and e are constants $cde \neq 0$ and value of k substituted. Allow with k replaced by $1/k$, error due to $k(N^{-3/2})$ when separating variables in **8(a)**. OE ISW e.g. $N = \left(-\frac{10}{0.7125\sin 0.02t - 1}\right)^2$ $N = \frac{1}{(-0.0713\sin 0.02t + 0.1)^2}$ $N = \frac{100}{\left(\left(\frac{0.6}{\sin 1}\right)\sin 0.02t - 1\right)^2}$ $N = \frac{1}{\left(\frac{3}{-50\sin 1} \times \sin 0.02t + \frac{1}{10}\right)^2}$ $N = \left(-\frac{0.06}{\sin 1}\sin 0.02t + 0.1\right)^{-2}$ $N = \left(\frac{800}{80 - 57sin 0.02t}\right)^2$ Do not need to substitute for $\sin(0.02t) = 1$, but must substitute for k.
	Accept answers between 1209 and 1215	**A1**	ISW Substitute $\sin 0.02t = 1$ or $t = 50\sin^{-1} 1$ or 78.5 or 25π. Answer with no working (rubric) 0/2. **SC** $N = \ldots$ not seen but correct numerical answer **B1** 1/2.
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