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Q4

Q4 $\frac{dv}{dt} = 1 + 12\cos(2t)$ $\qquad V(0) = 2 \qquad X(0) = 0$

$$\int dv = \int \left(1 + 12\cos(2t)\right) dt$$

$v = t + 24\sin(2t) + C \rightarrow V(0) = 2 = 0 + 24\sin(0) = 0$

$$\boxed{V(t) = t + 24\sin(2t)}$$

$V(t) = \frac{dx}{dt} = t + 24\sin(2t) \rightarrow \int dx = \int t + 24\sin(2t)\, dt$

$X = \frac{t^2}{2} - 48\cos(2t) + C \rightarrow X(0) = 0 = 0 - 48\cos(0) + C$

$\therefore X(0) = 48 \qquad \therefore C = 48 \qquad \therefore \boxed{X(t) = \frac{t^2}{2} - 48\cos(2t) + 48}$

$X(\pi) = \frac{\pi^2}{2} - 48\cos(2\pi) + 48 = \frac{\pi^2}{2} - 48 + 48 \quad \boxed{= \frac{\pi^2}{2}}$