

10(b)

$$(ii) \quad \frac{dv}{dt} = \left(1 - \frac{v^2}{3200}\right)$$

$$\int_0^v \frac{3200}{3200 - v^2} dv = \int_0^t dt$$

$$\left[20\sqrt{2} \ln \left(\frac{40\sqrt{2} + v}{40\sqrt{2} - v} \right) \right]_0^v = t$$

$$20\sqrt{2} \ln \left(\frac{40\sqrt{2} + v}{40\sqrt{2} - v} \right) - 0 = t$$

$$\frac{40\sqrt{2} + v}{40\sqrt{2} - v} = e^{t/20\sqrt{2}}$$

$$\frac{(40\sqrt{2} - v) - (40\sqrt{2} + v)(-1)}{(40\sqrt{2} - v)^2} \frac{dv}{dt} = \frac{1}{20\sqrt{2}} e^{t/20\sqrt{2}}$$

$$\frac{dv}{dt} = \frac{(40\sqrt{2} - v)^2}{80\sqrt{2}} \frac{1}{20\sqrt{2}} e^{t/20\sqrt{2}}$$

$$\text{For maximum speed } \frac{dv}{dt} = 0$$

$$0 = \frac{(40\sqrt{2} - v)^2}{80\sqrt{2}} \frac{1}{20\sqrt{2}} e^{t/20\sqrt{2}}$$

$$\Rightarrow v = 40\sqrt{2}$$

$$\Rightarrow v = 56.57 \text{ m/s}$$

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