

01910(5)

(i)

$$F_{resist} = -k v^2$$

$$m a = -k v^2$$

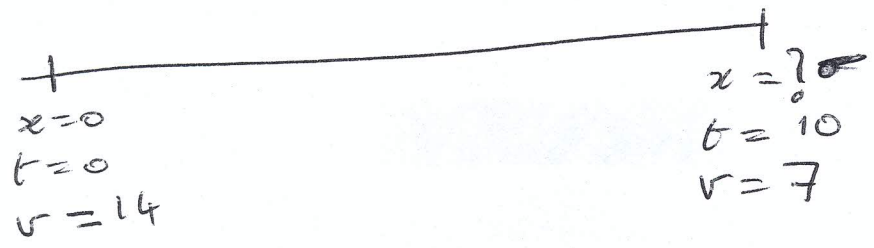
$$\Rightarrow \frac{dv}{dt} = -k v^2$$

$$a = -k v^2$$

See typed alternative for (ii)

(5)

$$\Rightarrow \frac{dv}{dt} = -k v^2 \quad \text{or} \quad v \frac{dv}{dx} = -k v^2$$



Link v and t:

$$\frac{dv}{dt} = -k v^2$$

$$\Rightarrow \int_{14}^7 \frac{1}{v^2} dv = \int_0^{10} -k dt$$

(5)

$$\int_{14}^7 v^{-2} dv = -k t \Big|_0^{10}$$

$$-\frac{1}{v} \Big|_{14}^7 = -k(0) + k(0)$$

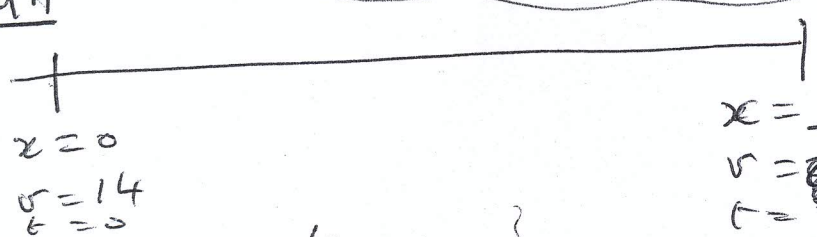
(5)

$$-\left[\frac{1}{7} - \frac{1}{14}\right] = -k \cdot 10$$

$$\boxed{\frac{1}{140} = k}$$

(5)

(ii) method A



(15)

$$\Rightarrow \int_{14}^{\bar{v}} v^{-2} dv = \int_0^T -k dt$$

$$\Rightarrow -\frac{1}{v} \Big|_{14}^{\bar{v}} = -k t \Big|_0^T$$

$$\Rightarrow -\left[\frac{1}{\bar{v}} - \frac{1}{14}\right] = -\frac{1}{140} [T - 0]$$

$$\Rightarrow \frac{1}{\bar{v}} = \frac{10}{140} + \frac{T}{140}$$

$$\Rightarrow \frac{1}{\bar{v}} = \frac{10+T}{140}$$

$$\Rightarrow \bar{v} = \frac{140}{10+T}$$

x=5
v=1/2
t=T

$$\frac{dx}{dt} = \frac{140}{10+T}$$

$$\int_0^5 dx = 140 \int_0^T \frac{1}{10+T} dt$$

$$x \Big|_0^5 = 140 \ln(10+T) \Big|_0^T$$

$$5 - 0 = 140 (\ln(10+T) - \ln(10))$$

$$\boxed{5 = 140 \ln\left(\frac{10+T}{10}\right)}$$