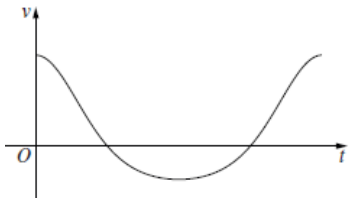
19 M **16 b** particle moves in a straight line, starting at the origin. **3**



Its velocity, v ms^{-1}, is given by $v = e^{\cos t} - 1$, where t is in seconds.

The diagram shows the graph of the velocity against time.

Using one application of *Trapezoidal rule**, estimate the position of the particle when it first comes to rest. Give your answer correct to two decimal places. **Changed from Simpson's rule by projectmaths.*

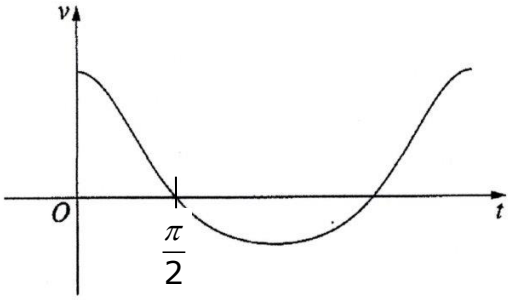
$v = e^{\cos t} - 1 = 0$

$e^{\cos t} = 1$

$e^{\cos t} = e^0$

$\cos t = 0$

$t = \frac{\pi}{2}, \ldots$ ✔



$$\int_0^{\frac{\pi}{2}} \left(e^{\cos t} - 1\right) dt \approx \frac{\frac{\pi}{2}}{4}\left[f(0) + f(\tfrac{\pi}{2}) + 2f(\tfrac{\pi}{4})\right] \checkmark$$

$$= \frac{\pi}{8}\left[(e^{\cos 0} - 1) + (e^{\cos\frac{\pi}{2}} - 1) + 2(e^{\cos\frac{\pi}{4}} - 1)\right]$$

$$= \frac{\pi}{8}\left[e - 1 + e^0 - 1 + 2e^{\frac{1}{\sqrt{2}}} - 2\right]$$

$$= \frac{\pi}{8}\left[e - 3 + 2e^{\frac{1}{\sqrt{2}}}\right]$$

$= 1.482247314\ldots$

$= 1.48$ (2 dec pl) ✔

State Mean: **(0.89/3)**

Marking Feedback:
Students should:

☐ quote the Reference Sheet for Simpson's rule and understand the meaning of $\frac{b-a}{6}$ compared to the alternative formula using $\frac{h}{3}$

In better responses, students were able to:

☐ understand the time when the particle comes to rest occurs when $v = 0$

☐ show substitutions into Simpson's rule

Areas for students to improve include:

☐ understanding the difference between radians and degrees when using trigonometric functions

☐ understanding that three function values are required for one application of the rule

☐ simplifying expressions that involve a fractional common difference within a fraction